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Piston Methods

in the Rickenbacker Shop

By Fred H. Colvin
Editor, *American Machinist*

The methods and sequence of operations, as well as the devices used—Burnishing ring grooves, grinding relief and facing pistons to length

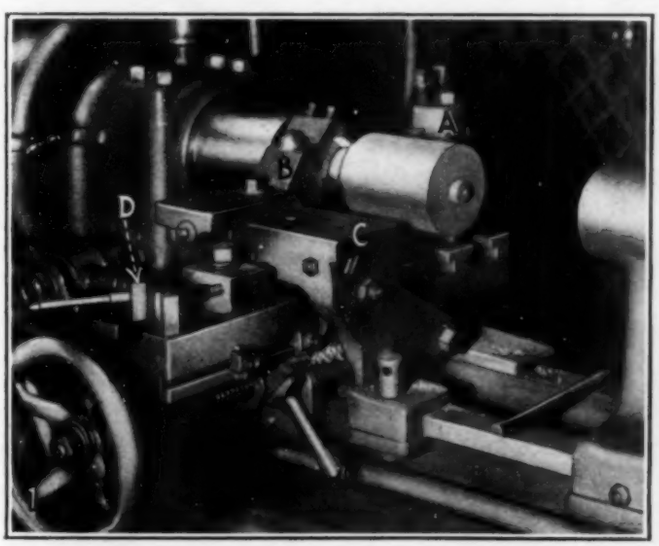
WHILE piston-making methods have been standardized to a considerable extent, there are still differences that afford interest to the tool designer and production man. The main requirement is to secure piston-pin holes at right angles to the body of the piston, while the diameter, the ring grooves and the relief at the piston-pin bosses also require careful attention in manufacture. Each production man has his own idea as to securing these requirements, with the result that many satisfactory methods have been developed.

After preliminary inspection as to the soundness of castings, the pistons are heat treated, pickled if necessary, and sand blasted before going to the first machining operation, shown in Fig. 1. The piston is held on an air-operated mandrel, the open end bored and faced, and the outer end centered with a center drill, on a Warner & Swasey turret lathe. The facing is done by the tool at the back of the cross-slide at *A*, while the open end is bored by tools in the head *B*, which is traversed by the slide *C*. Stops are set so that the inside length of the piston will be correct when tested by the gage *D*. The center drill is carried in the tail spindle.

Rough turning the outside diameter is done on a

SEQUENCE OF OPERATIONS

Heat treat	Drill two ¼-in. holes to inside of piston
Pickle if necessary	Spot face and mill slot
Sand blast	Turn two $\frac{1}{16}$ x $\frac{1}{4}$ grooves
Bore, center and face open end and center closed end and bore	Grind relief at pin hole
Rough turn OD, rough groove and face end up to boss	Burnish ring grooves
Finish turn and finish groove and chamfer closed end	Recenter
Drill and ream pin hole	Rough grind OD
Press in bushings	Finish grind OD
Drill twelve holes	Burr ring grooves
Drill two ¼-in. holes	Finish bore wrist-pin hole
	Rough grind and finish face
	Finish face open end to length
	Wash
	100% inspection



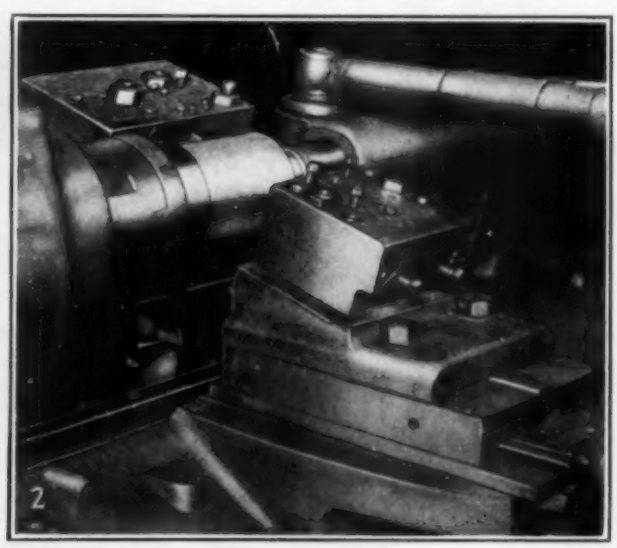
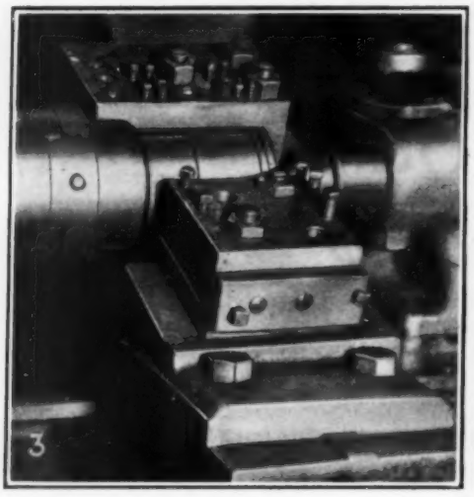


Fig. 1—Boring and centering piston. Fig. 2—Rough turning the outside

Automotive Production



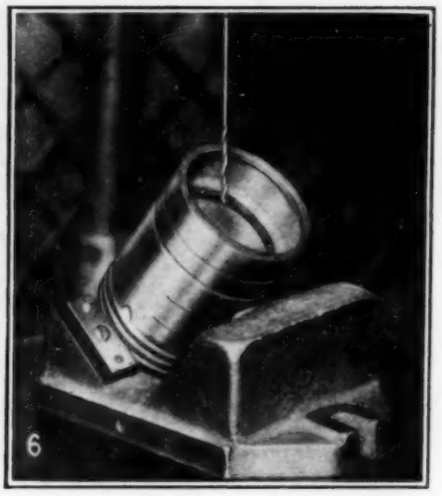


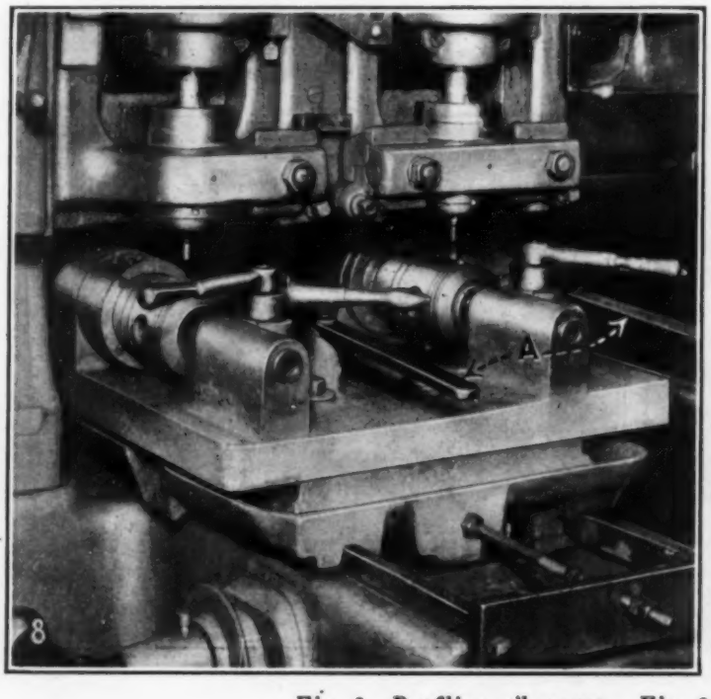
Fig. 3—Finish turning and grooving. Fig. 4—Drilling and reaming pin hole. Fig. 6—Drilling oil hole for pin.

Le Blond multi-cut lathe, as in Fig. 2. The end is also faced down to the boss in the center and the grooves are roughed out as well. The piston is centered at the outer end, and also by the hole and face of the open end of the skirt. A driver goes up inside the piston, between the piston-pin bosses. The finish turning is done on the same kind of a machine as in Fig. 3. The ring grooves are also finished and the end chamfered, and an oil collecting groove is cut below the piston-pin hole.

The piston-pin hole is drilled and reamed on a Colburn drilling machine, in the indexing fixture shown in Fig. 4. The piston is located by the open end and held by the screw in the strap that is fastened by the wing bolt at the end. The hole is reamed to 1.1865-1.188 in. to allow for pressing in a bronze bushing for the pin bearing. Magic chucks and collets are used to save time in changing from drill to reamer. The bushing is next pressed in on a Greenerd arbor press, using a pilot to aid in holding it straight.

Twelve oil holes, 0.116 in. in diameter, are drilled from the oil groove through to the inside of the piston. The fixture is shown in Fig. 5, the twelve holes being indexed by the cone-pointed plunger *A* snapping into the indentations in the plate *B*. The drill bushing is at *C*. The piston is held by a loose pin put through the pin holes and through the eye bolt *D*, and drawn back on the plug *E* by the hand nut at *H*.

The fixture in Fig. 6 is for drilling oil holes through the piston-pin boss and into the lower ring groove. There is one $\frac{1}{8}$-in. hole in each boss that feeds oil from the ring groove to the pin. Details of this fixture are shown in Fig. 7. The pin *A* enters the piston-pin holes



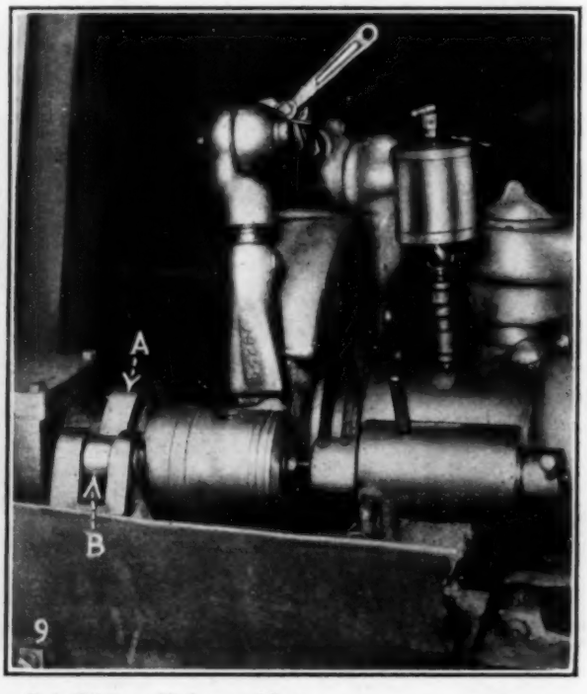
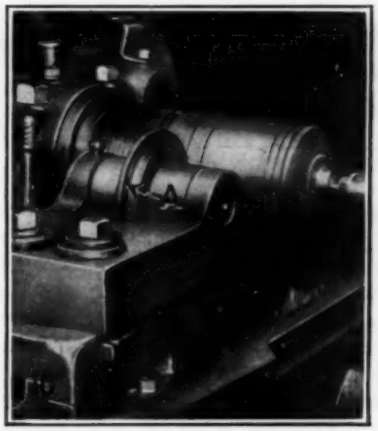


Fig. 8—Profiling oil recess. Fig. 9—Grinding relief on sides

Automotive Production



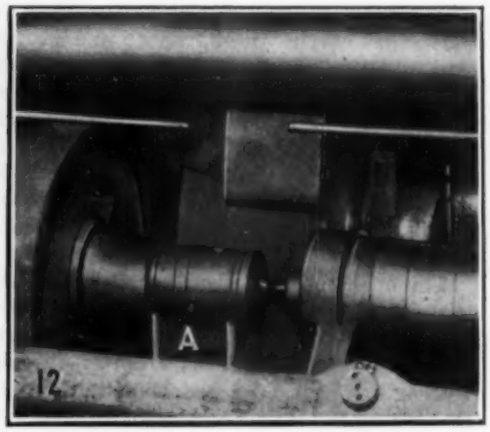


Fig. 10—Burnishing the grooves. Fig. 11—Recentering fixture for open end. Fig. 12—Finish grinding outside

as shown, the head end of the piston going between two guides. The drill is guided by a bushing in the pin at *B*.

A shallow slot is milled on the side of the piston to assist in getting surplus oil from the lower ring to an oil vent hole in the cylinder wall. The slots are milled in two pistons at once, on the Pratt & Whitney profiling machine shown in Fig. 8. The pistons are held by the open end and the center, and located by plugs in the piston-pin holes. The plugs are controlled by the levers *A*, while a stop on the table determines the length of the slots. The cutters are two-lipped end mills, $\frac{7}{8}$ in. in diameter.

Two shallow oil grooves, $\frac{1}{8}$ in. wide and $\frac{1}{64}$ in. deep, are turned in a Dalton lathe, after which the relief is ground on the sides of the piston, on the Landis grinding machine in Fig. 9, using a 36-J wheel, $1\frac{1}{8}$ in. wide. The fixture in which the piston is held is controlled by the double-lobed cam *A*. This cam, acting against the roller *B*, moves the fixture back and forth to secure the desired relief on each side of the piston.

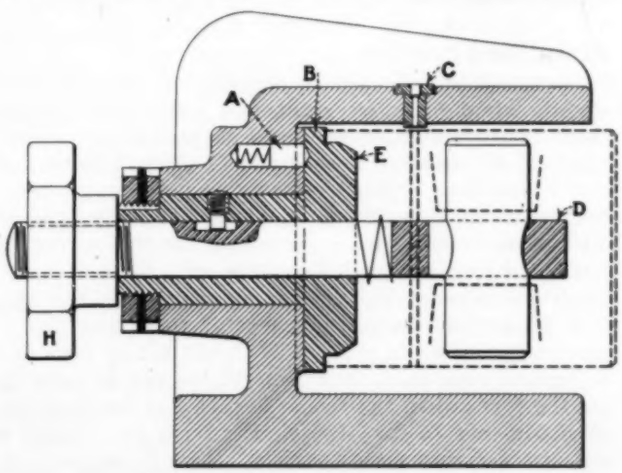


Fig. 5—Drilling oil-groove holes

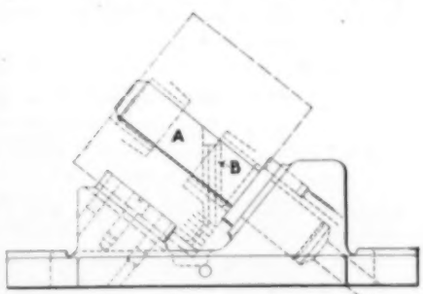
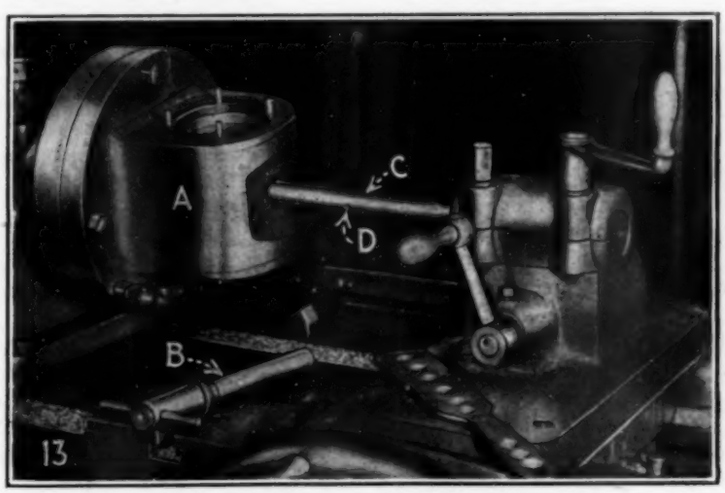


Fig. 7—Details of drilling fixture



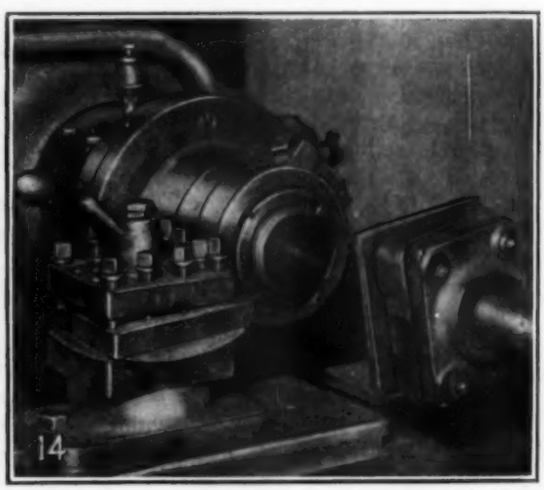


Fig. 13—Boring bushings with a diamond tool. Fig. 14—Facing and finishing end

Automotive Production

The ring grooves are next burnished, using a tool-block that carries the hardened and ground steel roller *A*, Fig. 10, in substantial bearings. The roller-burnisher is forced into the ring grooves and smooths the sides by compressing the metal, and removing any tool marks. This gives the sides of the grooves a finish that reduces the wear between the rings and grooves. It also aids in preventing ring slap and oil leakage to a considerable extent. The burnishing device is mounted on a Rockford lathe tooled for this operation only.

The open end of the piston is then re-centered, using the fixture in Fig. 11. This operation consists in rotating the piston, by hand, against a cutter fastened in the base of the fixture. This cutter is really an angular reamer having a 60-deg. included angle, that trims out the end of the skirt to insure its being concentric with the outside, before the grinding operation. The fact that this operation is performed by hand, indicates how little metal is removed and also the care taken to avoid stresses that might be set up by clamping for machine operation.

Then the outside diameter is next ground on a Bryant machine, Fig. 12, using a 303-R Carborundum wheel for both the rough and finish grinding operations. The wheel has a 6½-in. face, and is dressed to give the proper diameters to the different lands, as well as to the skirt proper. It will be noted that a rest is provided in front of the wheel at *A*, which makes it very easy for the operator to put a piston in place. When he withdraws the center, the finished piston cannot fall, though there is ample clearance so that the rest does not interfere with the grinding operation.

Ring grooves are burred in a Dalton lathe with a three-cornered, fine-cut file, and the bronze bushings are then bored for the piston pin on a special, Sundstrand lathe, Fig. 13, with a diamond tool mounted in the tool bar. The piston is held in the chuck *A*, shown at right angles to the spindle and the boring tool. The location is assured by the centering plug *B*. After the piston has been clamped in position and the centering pin withdrawn, the boring bar *C*, piloted at the inner end and carrying a diamond tool at *D* in a ⅞ in. holder, is fed through both bushings and back again by a cam feed. In this operation the holes are bored in line to 0.9988 inch.

The end of the piston is then finished by turning off the projecting center lug and then facing the end with abrasive cloth as in Fig. 14. A special chuck is used that supports the piston for nearly its whole length. The length is gaged from the end to the piston-pin hole and the piston is then reversed in the same chuck and the open end faced to length, to secure uniform weight within the prescribed limits.

Every piston is then inspected for diameter and location of grooves, for width of grooves, for distance from hole to each end of piston, and finally for the diameter of the piston-pin hole. Pistons are sorted as to diameter to assist in the assembling department, as is common practice in nearly all automobile plants.

In the assembly line, the piston-pin bushings are passed over a spiral burnisher that polishes the holes and enlarges them just enough to secure the proper fit on the piston pin.

Abstracts

from other publications

Valve Repairs

When it is necessary to grind a set of automobile valves they should first be refaced either on a valve refacing tool or on a grinder. When entering a valve in the collet of a grinder or guide refaced, place the valve so that the collet will hold the valve in the same position on the valve stem as the valve will be held in the valve guide. Feed the valve toward the wheel gradually, moving the valve backward and forward across the wheel slowly. Do not allow the edge of the wheel to grind on the valve face, as this will leave a ridge on the valve. The valve should be backed away from the wheel slowly to insure a true finish.

Carbon should be removed from the valve seat before grinding as it will cause the emery wheel to fill up unevenly. Worn valve stems should be replaced. Murray Fahnestock in *Ford Dealer and Service Field*, March, 1926, p. 61.

Simplified Service

Standardization and mass production of parts have greatly simplified and cheapened service by making parts for cars of the same make or model interchangeable and by reducing the number of sizes of bolts, nuts and connections. Much remains to be done, however, by automotive engineers in simplifying construction with a view to the tool equipment of the service department and repair shops. The lightening holes in crankshaft gears could be made of standard size and location so that one instead of about 48 types and sizes of gear remover would suffice. It should not be necessary to remove rear axles from beneath the car or move the engine forward in the frame to take out the transmission box, nor to take the engine from the chassis to get at the main engine bearings. Axle housings might be made in a way that the differential gears could be aligned without tearing down the entire axle assembly. Valve springs should be made accessible for removal of the valves for grinding without taking off the intake or exhaust manifold, and valve guides better placed.

General adoption of the flat rate system for service is forcing consideration of accessibility and time saving in servicing automobiles and compelling the tool manufacturer to provide special tools that will make repair work easy to perform and save time in the shop. Quickness and ease of servicing and availability of replacement parts are furnishing one of the best selling arguments for cars at the present time. B. C. Hinckley in *The S.A.E. Journal*, March, 1926, p. 268.

The result of the Ford air-transport experience shows an equivalent of 2,000,000 passenger miles without accident of any kind. As a result it is expected that during this year passengers will be carried between Detroit, Cleveland and Chicago at lower rates than formerly. Ford planes are sold only for commercial use, not to individuals.

A Production Hindrance and a Remedy

By Entropy

OFTEN my wanderings take me into shops that are not paying dividends. In one such shop I saw a girl who appeared to have plenty of work ahead of her, but who was taking life with ease. I watched her long enough to be sure that she would just as well have done twice as much work if she were so disposed, then I sidled up alongside and looked at the files she was using. They were so smooth that it seemed impossible to get out any production at all. Considering the files she was doing a pretty good day's work after all.

I asked her why she didn't get new files and make some money. Her reply was to the effect that if she had sharp files she couldn't help getting out so much work that they would cut her piece rate, and then she would have to work twice as hard for the same money. Asked if she didn't know the concern was practically on the rocks, she replied that they had been that way ever since she had worked for them, but that they always dug up some money for pay day and she guessed they always would.

Suspected Collusion

Then I went to the superintendent and asked him what would happen if one of the girls made twice as much money as usual. "I'd get called from the office, and they would probably refuse to pay on the ground that there was some collusion between the girl and the inspection department. They would fire some one out of that department, and then the girl would know better than to try to make more than $4 a day. And," he added, "that is enough for any girl to make."

Then I went to the general manager. He said they never cut piece rates, and anyone could make all the money possible. On further question, however, it developed that if he found anyone making very high pay, say more than $4 a day for a girl, he would think that the man who set the rate was playing favorities, and he would get after the superintendent with a red hot poker.

Then I dug up their piece rate sheets for several years back, and found one job that had had the rate cut six times in less than three years. The G. M. called in the Super to find out what it was all about, and it finally developed that each time the piece worker had made too much money they had changed the design of the piece, or the tools for making it, or the order in which the work was done.

This looks like a pure case of subterfuge. It looks the same to the workmen in the shop. They do not see the changes, in fact some of the changes are very minute. What they see is a part which looks the same, goes by the same name, and a price which grows less every time anyone makes any real money on it.

Now this is a condition that is not confined to the one shop. It prevails almost everywhere. It is not sanctioned by the management. It is not approved by the men who do the cutting. The latter cut the rates to hold their own jobs, and they put up the camouflage to preserve their superior's faces and because it makes them feel a little less mean.

Here is a condition that does prevail. Anyone who denies it is probably misinformed, or has buried his head in the sand so as not to hear. What is the solution? It is very simple, very expensive at first, very economical in the long run. It is this: Do not put a piece rate on a job until you know what is the best way to do it with the facilities that you have at hand, and also know how long it should take a live person to do it.

Neither of these things can be learned by standing with a stop watch in your hand, visible or invisible. Workmen in the shop do things the way they were taught, or the way they observed others, plus or minus some little personal idiosyncrasies. They have no time to experiment, and if they did they have small encouragement to give the management the benefit of their experimentation.

This work will have to be done by experts who have no thought of earning their living on the rates which they set. It will have to be done by men whose salaries are large enough so that the piece rates do not make their own mouths water for the chance to get in the shop and make a killing. And all that this requires is a scientific study of what it means to do each given job. In a shop where there are thousands of operations and hundreds of different pieces it will take years to rate every job. And yet, it is dangerous to put a single job on a piece rate until it has been the subject of exhaustive experiment.

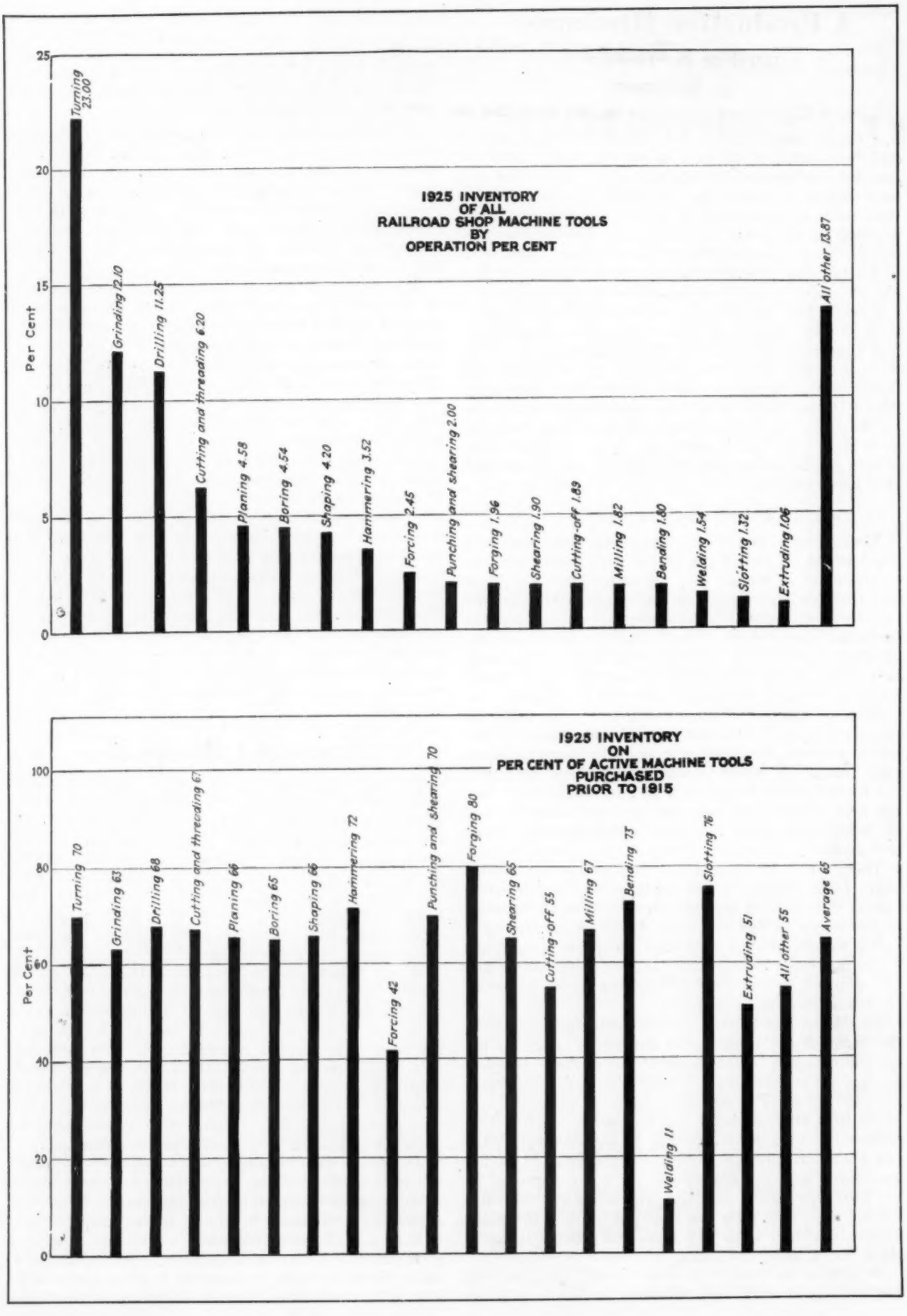
In the manufacture of wire, textiles and candy, to mention only a few things, this is done. No one thinks of offering a piece rate without full knowledge of what length of time is really necessary to do it. In most such industries men are not merely allowed, but encouraged to make large pay because the decrease in overhead is so great as to far overshadow the excess paid to the man. Why not do the same thing with the product of machine tools, whether that product be more machine tools or the multitude of things made by their use?

Tapers in Lathe Spindles

The question of tapers used in lathe spindles comes up from time-to-time and, in order to have definite information on the subject, we have secured data from the leading builders of lathes as to their practice. Without going into unnecessary details it may be said that the Morse taper is almost universal in lathe spindles, varying, with one exception, from No. 3 on 12 to 14-in. lathes to No. 7 on lathes from 42 in. to 72 in. swing. As a rule, 18-in. lathes have No. 4, 26-in. lathes, No. 5, and 36-in. lathes, No. 6 Morse taper.

Where hollow spindles are used, the taper on the spindle is of course larger, since it must hold the bushing that carries the live center. The difference varies from one to two numbers. In one well-known lathe, the taper in the spindle is a Jarno, while the lathe centers themselves are Morse. On a 16-in. lathe, for example, the outside of the bushing is No. 16 Jarno, while the lathe centers are No. 4 Morse. Another builder of high-grade lathes has modified the Morse taper by simply lengthening it without changing the angle.

As replies were received from 22 builders of lathes, the predominance of the Morse taper makes it almost unanimous and should standardization be considered desirable by the users of lathes, there would probably be little difficulty in determining on the taper to be used. It is also likely that an agreement as to which size of taper should be used on lathes of a given swing could also be reached without undue discussion or hesitation.


1925 INVENTORY
OF ALL
RAILROAD SHOP MACHINE TOOLS
BY
OPERATION PER CENT
Per Cent
0
5
10
15
20
25
Turning 23.00
Grinding 12.10
Drilling 11.25
Cutting and threading 6.20
Planing 4.58
Boring 4.54
Shaping 4.20
Hammering 3.52
Forcing 2.45
Punching and shearing 2.00
Forging 1.96
Shearing 1.90
Cutting-off 1.89
Milling 1.82
Bending 1.80
Welding 1.54
Slotting 1.32
Extruding 1.06
All other 13.87
1925 INVENTORY
ON
PER CENT OF ACTIVE MACHINE TOOLS
PURCHASED
PRIOR TO 1915
Per Cent
0
20
40
60
80
100
Turning 70
Grinding 63
Drilling 68
Cutting and threading 67
Planing 66
Boring 65
Shaping 66
Hammering 72
Forcing 42
Punching and shearing 70
Forging 80
Shearing 65
Cutting-off 55
Milling 67
Bending 73
Welding 11
Slotting 76
Extruding 51
All other 55
Average 65

How Railroad Repair Shops Are Equipped

A Statistical Analysis of the Types of Equipment and Their Relative Ages

WHAT constitutes the mechanical equipment of the railroad shop?

What is the relative importance of particular classes of tools?

What is the relative importance of types within the classes?

What is the relative age of various classes of tools?

The answers to these questions are based on the replies to a questionnaire sent out by the *American Machinist* to the executives of the Class I steam railroads, and are laid out here in three charts in terms of per cent of the total. The replies represent 30 per cent of the class I railroads.

The equipment reported was grouped under operation headings, turning, grinding, drilling, etc., and these groups were compared against the total to show, in the first chart, the relative importance of classes individually as far as those representing more than one per cent of the total were concerned. Those below this figure are grouped under the heading "All Other Tools." Portable tools and small tools were not considered.

Equipment for turning, grinding and drilling represents approximately one-half of the total and includes the principal outstanding installations from the standpoint of quantity. That turning should lead is the normal result of the range of usefulness of this equipment in the railroad shop. Grinding and drilling show large numbers because of the quantity of small drilling machines and grinding stands in active service. Machinery for all other purposes grades down as shown without further abrupt difference in quantity.

The questionnaire was arranged to show, by separate grouping, that part of the equipment which was purchased prior to 1915, or, in other words, ten years old or older. This grouping was used in constructing the second chart which gives the answer to the question of age. The same operation classification, as made for the first chart, is used.

It can here be seen that forging machines have seen the most service, 80 per cent being 10 years old or older. Machines for bending, hammering, punching and shearing, and turning show 73, 72, 70 and 70 per cent, respectively, to have had 10 years or more of active service. The newest class is welding where the greater proportion of the equipment has been installed in the past ten years. This is due of course to the comparative newness of the welding art commercially applied. The average of all the equipment shows 65 per cent beyond the ten-year point. With the exception of one or two instances, such as welding and forcing, the individual age is quite close to the average.

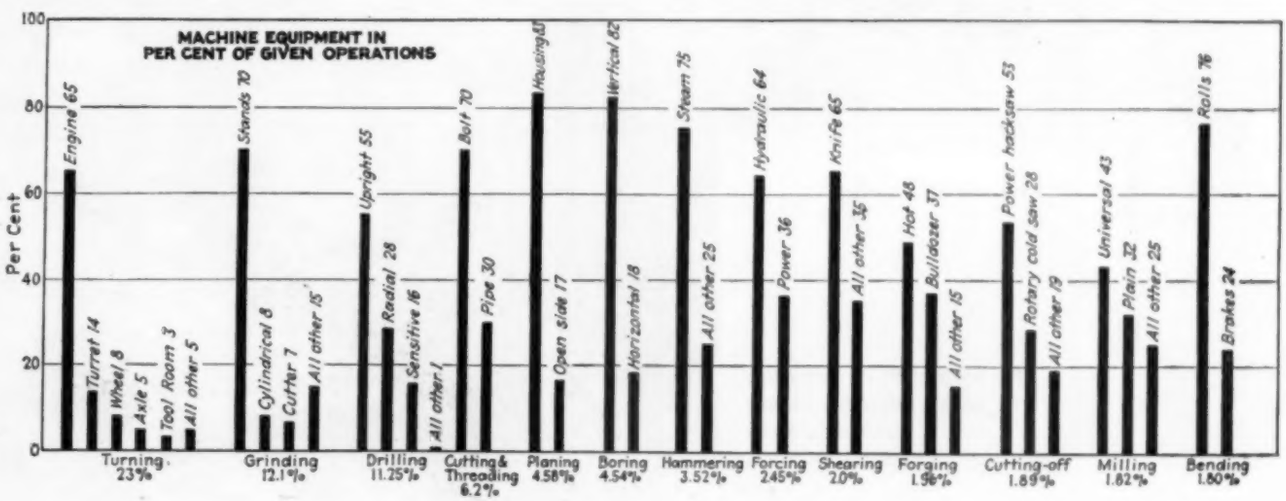
The classes of equipment are divided into individual types of machines in order to construct, in the third chart, a graphic analysis of the relative numbers of each machine in quantity service.

As shown in this third chart, the all-purpose engine lathe vindicates its reputation for popularity by holding 65 per cent of the total installations for turning work. The turret lathe comes next with 14 per cent, giving the two together a little more than three-quarters of the total.

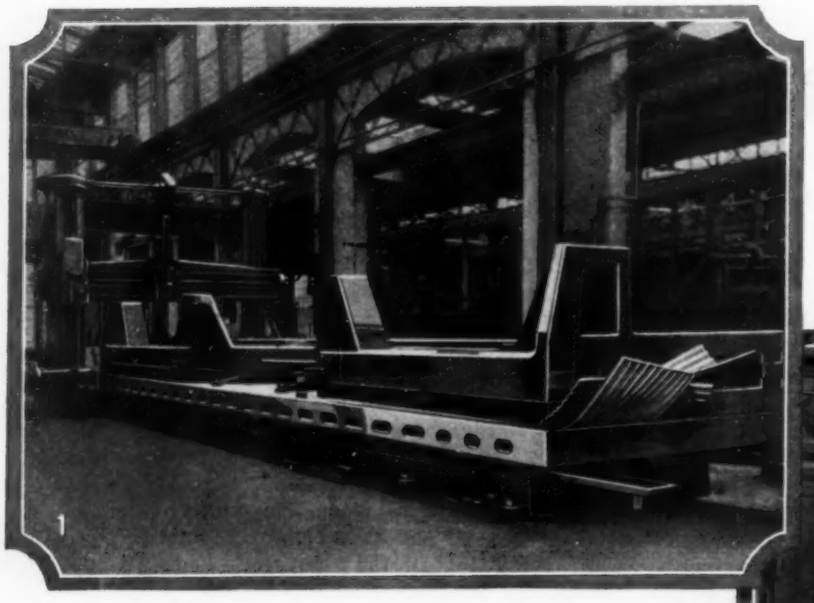
Grinding stands represent nearly three-quarters of the grinder classification but this fact is not so significant when the stands themselves are compared to the larger machines for other grinding purposes. Some changes in proportion may be forcasted as a result of the work being done by the grinder manufacturers to widen their field of application.

Each class shows one or more distinctive machines but there is no need, here, for further analysis other than to say that this third chart is made up from those operation classes in which there were more than one type within the class that could be compared to advantage.

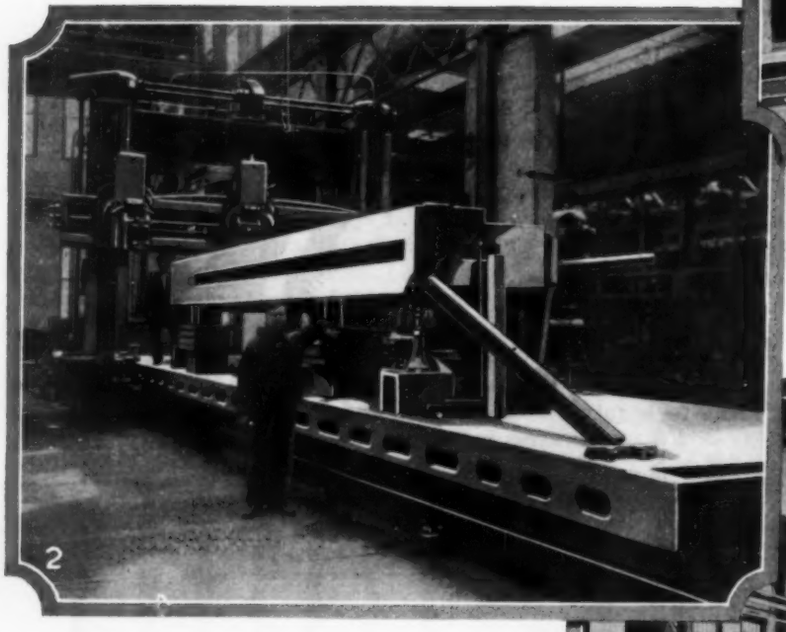
Another article will be based on total quantities rather than per cent and is now being made ready for publication in an early issue.



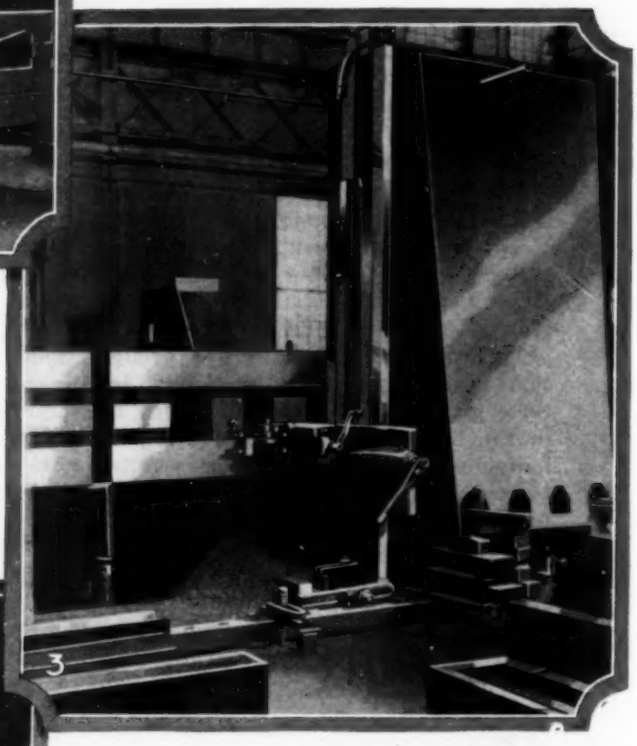
Building Boring Mill



1—Planing the housings

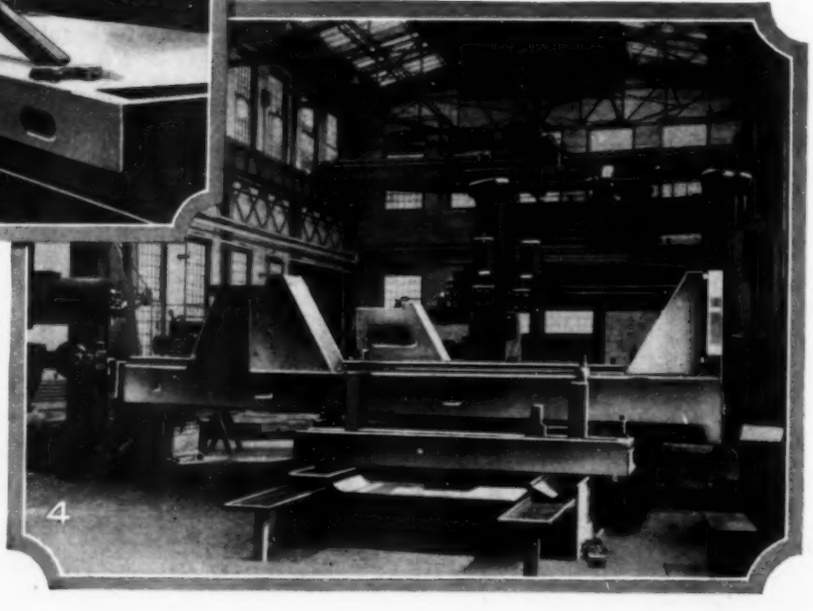


2—Finish planing cross-rail bearing of housing



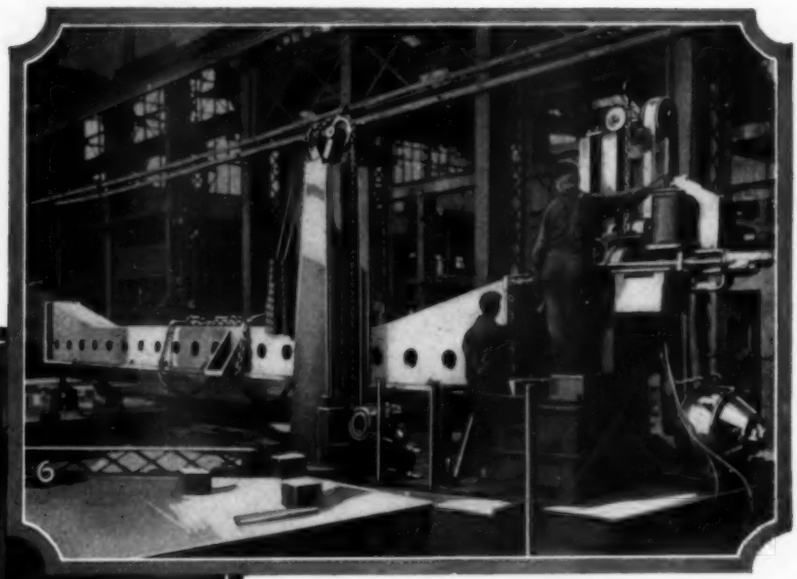
3—Planing base of housing, using column and side head of open-side planer

Photographs from the Bertram Works,

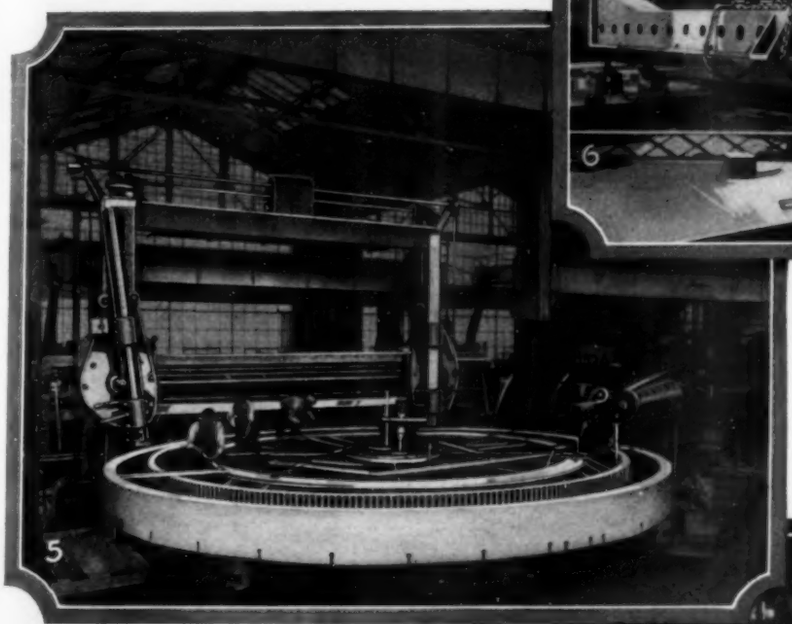


4—Planing ends of housing, using adjacent planer and side head

a Large in Canada

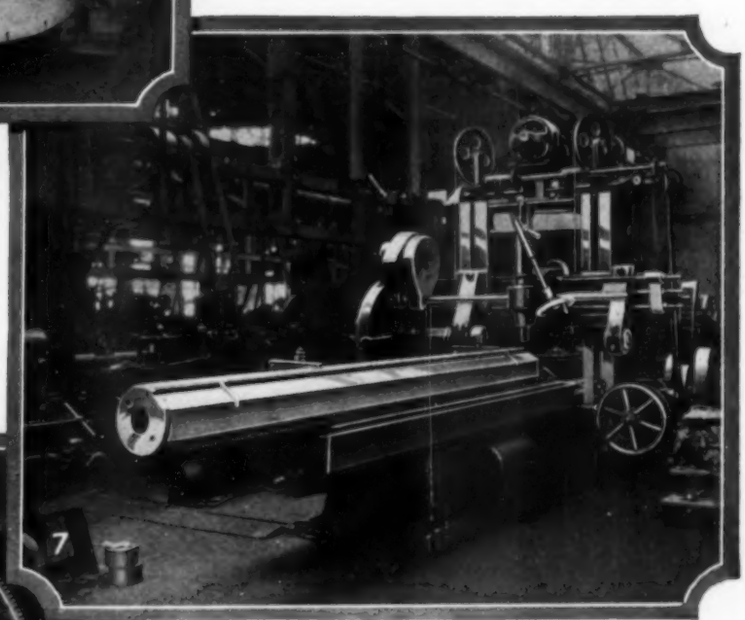


6—Drilling the top bridge

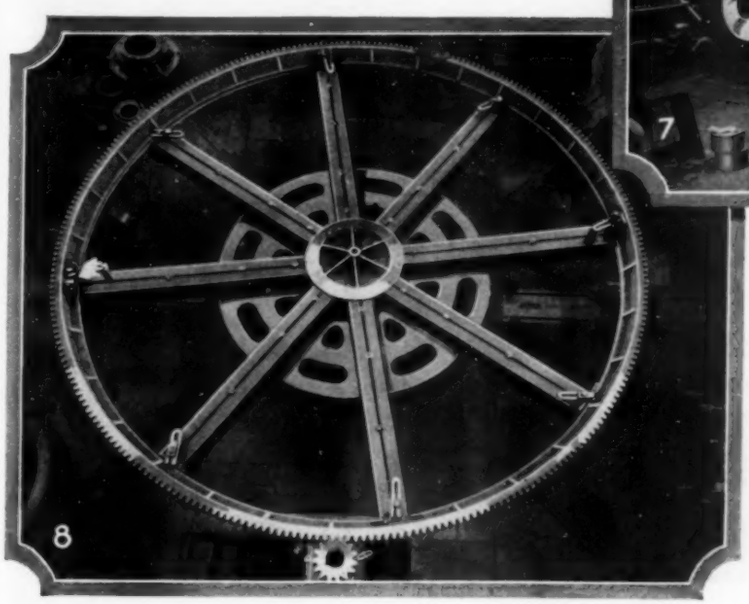


5—Scraping the table track

by courtesy of the Niles-Bement-Pond Co.

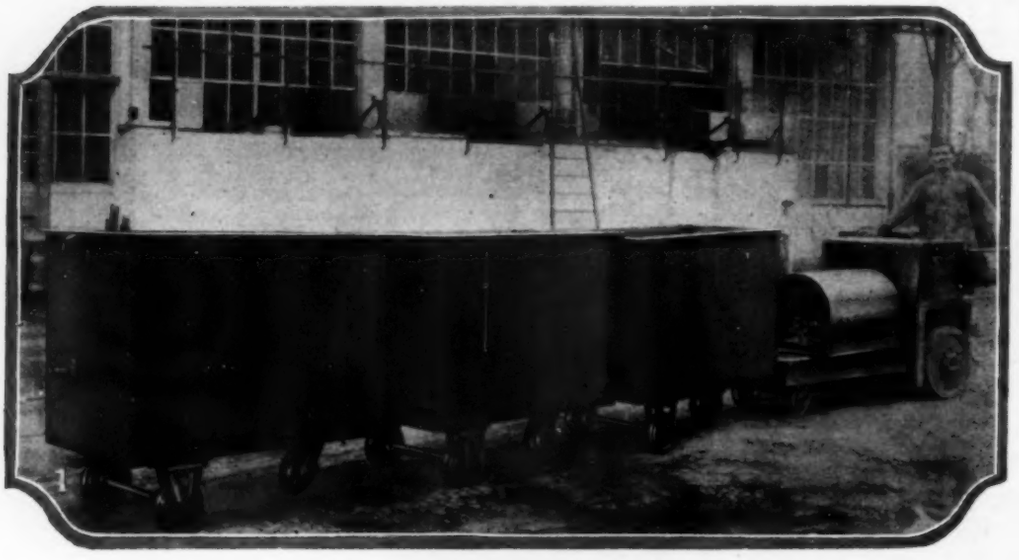


7—Milling keyseat in the tool bar

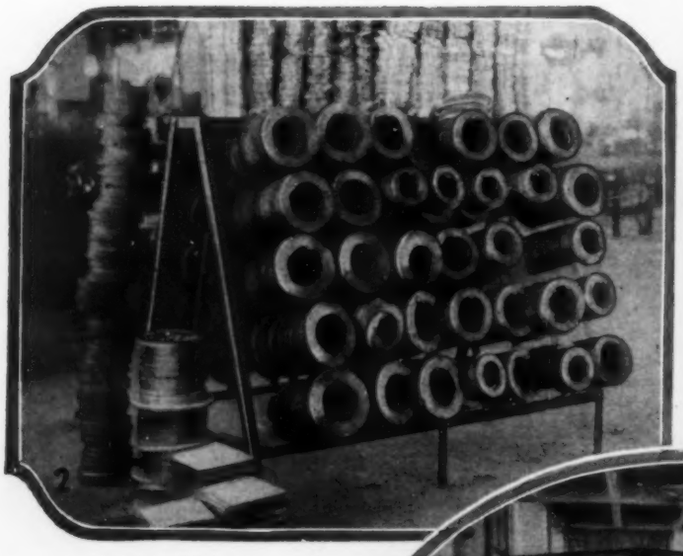


8—Inspecting the table gear for center distance

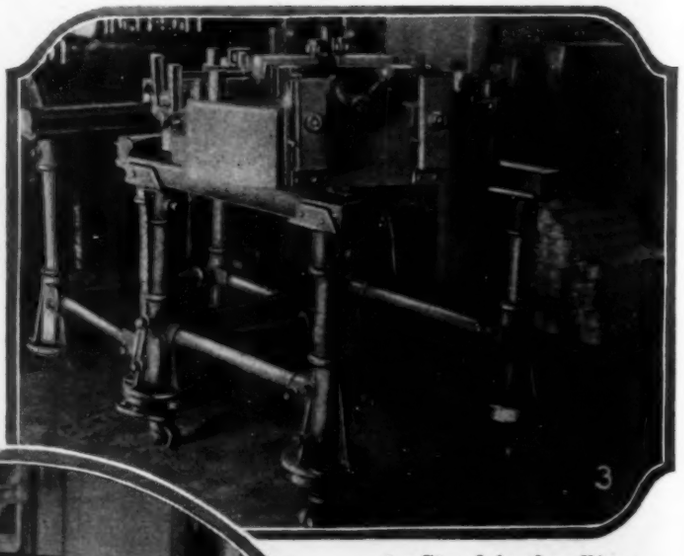
Transportation Units



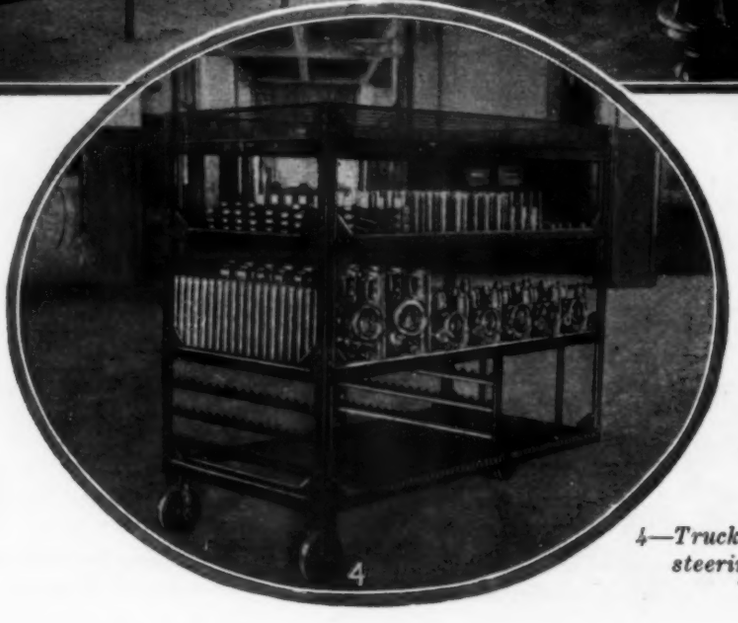
1—Transporting stock and chips



2—Racks for the clutch disks

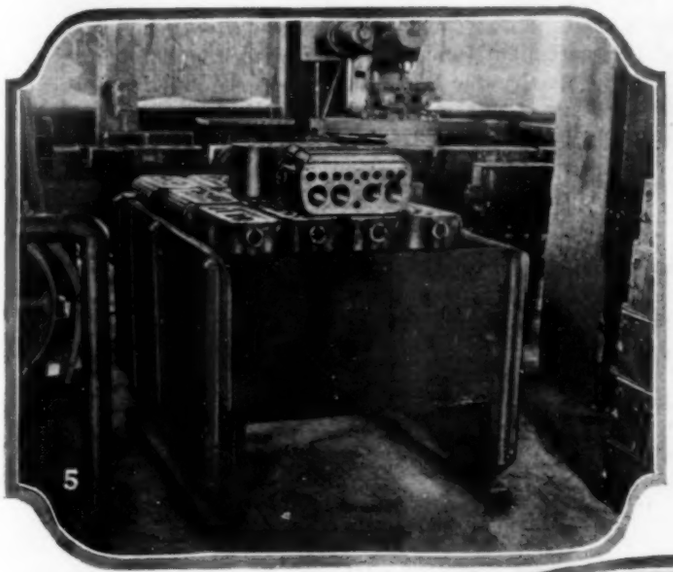


3—Stand for handling large fixtures

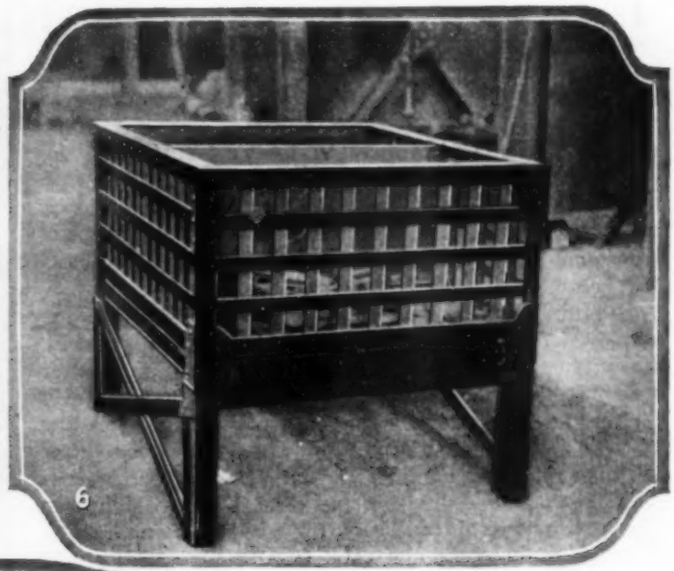


4—Truck for parts of steering mechanism

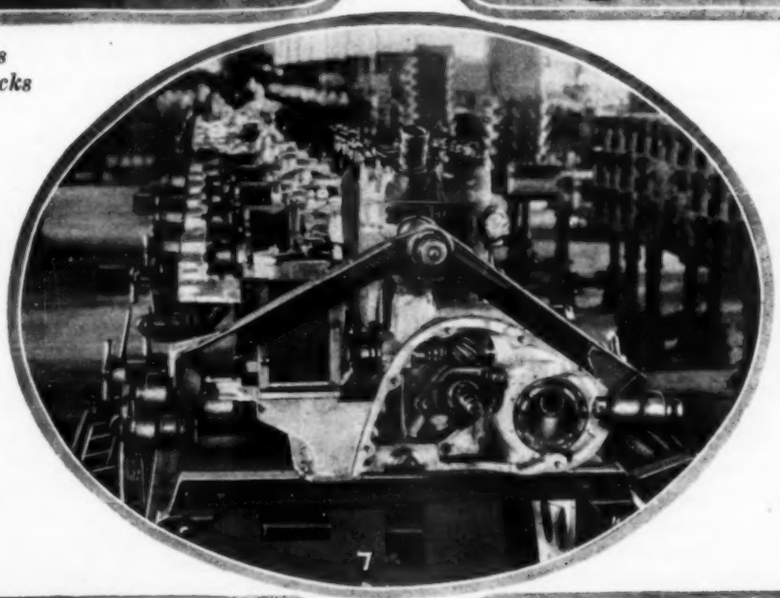
in the Fiat Works



5—Lift-truck boxes for cylinder blocks



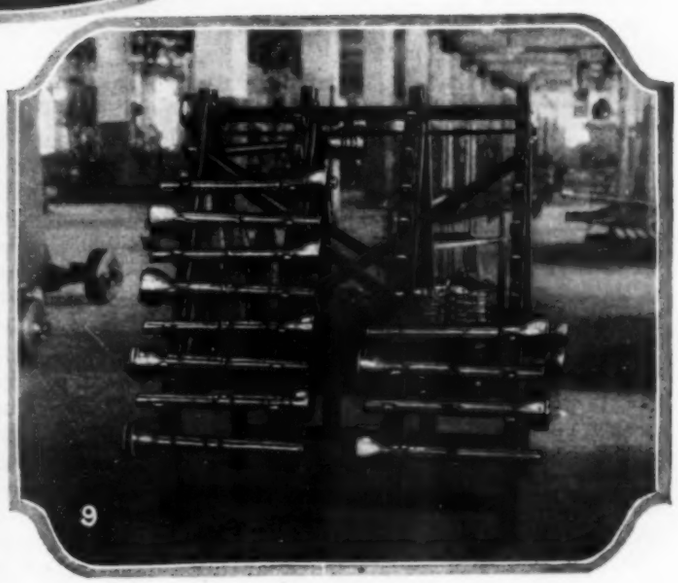
6—Carrier and bin for forgings



7—Motor supports during assembly

8—Another type of parts stand

9—Rack for universal joints



The Liability of Employers

By Leslie Childs

THE law generally recognizes that an employer is bound to furnish his employees with tools and instruments that are reasonably safe for the work intended. However, there is a well-defined exception which holds that where the duty of an employee involves the repair of a tool for his own use, and an injury results from the improper repairing of such tool, the employer may not be held liable. Of course, each case arising under this rule must be decided in the light of its facts, but the foregoing constitutes the common law rule, and, as an example of its application, the following recent case may be reviewed with profit.

In this case a young man named Farmer was employed by a large railway company as a repair man. He was experienced in this work, and with two other men was assigned the task of removing a dent from a 50-ton steel coal car. To do this work it was necessary to heat a section of the car to soften the steel so that the dent might be hammered out. This heating process was accomplished by the use of a torch, which was operated by fuel oil and compressed air drawn through sections of hose from a tank several feet away.

A Fatal Repair Job

When Farmer and his companions turned on the air pressure they discovered that the rubber oil line was leaking near the tank. Farmer thereupon proceeded to repair the oil hose by cutting off the ends of the hose at both ends, and reattaching to the torch and tank.

Following this the torch was placed in operation, and because of faulty connections the oil hose blew off of the nipple at the tank and sprayed Farmer with oil. This oil immediately ignited, and Farmer was burned so severely that he died that same day. Action was thereafter brought to recover from the railway company for his death.

This action was based on the contention that Farmer's death was caused by the negligence of the railway company in failing to keep the oil hose and automobile valve in repair, and failure to instruct Farmer how to use the torch. The railway company on the other hand took the position that the accident was caused by the negligence of Farmer in failing to repair the hose properly when he ascertained it was leaking. Upon trial the court dismissed the complaint, holding that the evidence would not support a judgment against the railway company. The following gives the main points of the ruling of the higher court in reviewing the evidence when the case was appealed.

"As a general rule, it is the duty of the master to use ordinary care to furnish his servants with tools and utensils that are reasonably safe for the use to which they are to be applied. But he is not an insurer of the safety of the servant, and is liable for the consequences of negligence, not of danger.

"The general rule stated above is, however, subject to the exception that, where the very work the servant is employed to do involves the construction or repair of an instrumentality for the use of himself or others, and he knows or ought to know the dangers involved, and of the proper method of construction or repair, the master is not liable for an injury to the servant resulting from his improper construction or repair."

Following the above statement of the general rule in situations of this kind, the court directed its attention to a review of the facts in hand, relative to the application of the rule. In this connection the court said:

"Farmer was an experienced car repairer. He had had a year and a half experience before he was employed by the defendant, and had been with the defendant in that capacity for 8 or 9 months, and during that time had used this appliance at least 10 or 12 times. He knew perfectly well, as soon as he tested the hose and found a leak, how to render it safe.

Mistaken Judgment

"The hose was sound and safe throughout its body, but was defective at the ends. It was necessary to cut off the defective ends back to the sound and safe part, and this he assumed to do without assistance or advice from the defendant, or any one authorized to represent it. He either did the cutting himself, or was present directing and assisting in it. In this he exercised his own judgment and not the judgment or direction of the defendant. He undertook to render the hose safe for the use of himself and his fellow workmen. If in the particular instant it proved to be unsafe, it was because Farmer did not cut off enough from the end, a matter about which he exercised his own judgment, and for which the defendant is not liable.

"Under the circumstances, the condition of the hose and the failure to inspect it cannot be said to be a violation of the duty which the master owed to his servant. The use of the torch was within the line of the employment of Farmer, he was familiar with its use, he was competent to make this necessary preparation, and if, in consequence of his own acts, injury and death have resulted to him, the defendant cannot be held liable."

Judicial Reasoning

It is of course obvious that the foregoing holding is based on the common law rule, announced at the beginning of this article, and is not tempered by any statutory provision relieving the employee of the assumption of risk of his employment. With this in mind, the holding constitutes a striking example of judicial reasoning on the question of when the improper repair of an instrument by an employee may relieve the employer from liability therefor.

Diction in Catalogs—Discussion

By J. S. Karlberg

Mr. Stern's "outburst" in the *American Machinist*, Vol. 64, No. 11, p. 438, causes me to wonder whether he peruses a catalog to obtain useful information, or to find errors in English. As catalogs are essentially to convey information to the man concerned with the shop, I fail to see where a few grammatical errors will cause him any great mental anguish.

To my mind an engineer's report does not necessarily have to be a gem of literary composition in order to be understood. My feeble efforts at letter writing may cause some lexicographer to tear out his hair, but I trust I at least make myself understood.

At 5c. a kilowatt-hour, one large firm finds that current for arc welding costs about 3c. per running foot for sheet metal work.

Industrial Americanization and the Foreman

By Fred Hamilton Rindge

The key position of the foreman in American industry—How he can help Americanization work and incidentally increase production and promote safety

"I AM the immigrant. My wanderlust was born of the craving for more liberty and better wages for the sweat of my face. I looked toward the United States with eager eyes kindled by the fire of ambition, and heart quickened with new hopes. I approached its gates with great expectations. I entered it with fine hope. I have shouldered my burden as an American man of all work. I contribute eighty-five per cent of all labor in slaughtering and meat packing industries. I do seven-tenths of the bituminous coal mining. I do seven-eighths of all the work in the woolen mills. I make nineteen-twentieths of all the clothing. I manufacture more than one-half the shoes. I build four-fifths of all the furniture. I make one-half of the collars, cuffs and shirts. I turn out four-fifths of all the leather. I make half the gloves. I refine nearly nineteen-twentieths of all the sugar. I make one-half of the tobacco and cigars. And yet, I am the great American problem."

If a common "dago" said something like this in the shop or mine, would the foreman throw bricks at him, discharge him or agree with him? In any event the foreigner is right. He has been trying to tell us these things for many years, but we have been too busy, prejudiced or unsympathetic to understand. The foreigner's English may be poor, but the foreman's appreciation of him is often worse! Fortunately, conditions are changing, and the new type of boss is a leader, not a driver of men.

Most Immigrants Unskilled

Over eighty per cent of our immigrants in America are unskilled laborers. They engage in those spheres of employment that demand more brawn than brain. They dig ditches in our cities and towns; they handle goods on the wharfs and dig oysters in the bays; they construct railroads and keep the tracks in repair; in iron and steel mills their strong arms perform the common labor; in our mines and around our collieries, these "foreigners" put their shoulders under the heaviest part of the load and are cheerful under burdens the Anglo-Saxon declares intolerable. Never in the history of the world have a people been more literally "hewers of wood and drawers of water" than the Slavs, Lithuanians, and Italians in the United States. The danger incident to mining, quarrying and tunneling; the exposures in railroad construction and maintenance; in building operations and street digging; the arduous labor in iron and steel mills have no terrors for them. Cut off this labor supply and many of our industries would be paralyzed, our industrial development would be arrested, the labor force of America would have to be wholly rearranged.

In spite of all that is said to the contrary, intelligent foremen and others in industry are realizing that immigrants do not always "lower standards." Sooner or later there is a tendency for them to push upward the native workers and assume the most menial tasks themselves. This pressure from below, although ultimately beneficial to the American, is, of course, contrary to his will. He is pushed out of his job by invaders from a foreign country, wages are lowered, the labor market is demoralized. For these reasons "foreigners" are hated by the rank and file of English-speaking employees. The foreigner may, in times of industrial conflict, be a greater menace to life and property than his more stable Anglo-Saxon fellow-workman; but under normal industrial conditions his thrift, industry and obedience should be appreciated and an effort put forth to make of this newcomer a friend and brother.

Agricultural Communities Breed Healthy Workers

About sixty per cent of our immigrants come from agricultural communities. No matter what is said of their coarse diet, the sunshine, pure air and pure water have developed a physical organism in many of these immigrants that we may well envy. With all their faults a surprising proportion of them are genial and buoyant under difficulties. Unfortunately, their industrial efficiency is often decreased by poor living conditions. Intelligent employers are now realizing that this does not pay. Many foreigners live in abodes that cannot be called houses, they take work that has been forsaken by others, and endure hardships that would discourage men of a more sensitive nature. They appreciate favors shown them, they are anxious to please and to learn, they are brave and amenable to discipline, intensely practical and thrifty, they love their families and their church, and become American citizens often for the sake of their children, whom they are anxious to start in life on a higher plane than their own. Whenever opportunity is offered, they build homes, erect churches, have their sacred burial place and priests of their own nationality. These are the only churches in America where the number of males is threefold the number of female attendants, and never have immigrants given of their earnings more freely for church edifices and parsonages than those from Southeastern Europe. This is only one of many significant facts, too frequently overlooked.

The assimilation of the immigrant has been only partially successful in the past, because the massing of non-English speaking workers by themselves has offset Americanizing influences in the community; and because the harsh treatment sometimes accorded them in industry has created a distorted view of the spirit and meaning of American institutions. No Americanization plan will succeed that is not predicated on the idea of influencing the immigrant's work environment, as well as his community life.

We are all to blame for past failures, but if one class of citizens more than another is responsible for this situation, it is the foremen of the country. They are closest to the workers during working hours, and are supposed to be the human engineers in industry. We deplore the fact that, as a class, the bosses are often cynical of the foreigners and the foreigners are suspicious of them. This is in no small measure due to the barrier of language, and emphasizes the fact that, to meet the situation, we must attack the problem at just this point. The foremen, standing strategically between management and men, do not welcome a critical and exhortive attitude on the part of the welfare director or even the superintendent or general manager. Nevertheless, encouraging the foremen to Americanize their departments will lead them to think of and work for their employees, unselfishly. This will promote a common interest which does not directly pertain to their work.

Efficient, modern systems of English instruction aim, by use of the dramatic method, to teach the particular sentences that express the foreign-born worker's daily experiences. With one of these systems the foreman may quickly learn how to teach his men the English of their jobs during working hours. The foreigner, while being instructed in the technique of his work, should acquire the use of those expressions that describe his work operations. In this way he gets the foundation for absorbing other words and phrases he overhears, and unconsciously drifts into an effective use of our language. A "Foremen's Americanization Club" should be organized, to meet at a series of dinner conferences for discussions which will further intensify interest, teach methods and increase knowledge regarding the various nationalities in the plant or mine. Busy foremen cannot be expected to do all the teaching of English and citizenship themselves, but volunteer or paid teachers can readily be enlisted from among the office force, engineers, interested American workingmen and others. Many plants now hold classes on company time once or twice a week for an hour after the whistle blows. Needless to say such work pays not only from the human standpoint but in dollars and cents as well.

Inability to Read Causes Accidents

The teaching of English has been found by scientific investigation to greatly decrease accidents. It is now well known that the inability to read warning signs, to comprehend fully the company's instructions and to understand their foremen, places an unnecessary hazard upon the foreign-born. In the Pennsylvania anthracite mines 43 per cent of the employees are English-speaking and this number is charged with only 28 per cent of the fatalities, whereas the other 56 per cent sustained 71 per cent of the fatalities. This is a comparative ratio of 669 to 1,288 against the non-English speaking. In the Pennsylvania bituminous mines the ratio is 771 to 1,123, and in the West Virginia district, 790 to 1,424.

If every foreman would regard himself a personnel developer, he would have a great deal less trouble, insofar as his men are concerned, in getting the work out on time. This was indicated in a recent conversation with an intelligent worker in one of the shops. He remarked, "A man is just looked upon as a piece of machinery, with only one difference; they have to speak to a man, and a machine they just turn on! All you ever hear around this place is must, must. We would work harder for a man if he talked to us as if we were human beings." Every foreman should realize that the awakening of personal initiative in his men is a part of his daily duty. Recognition and initiative develop a man, make him a better worker and undoubtedly help him to live more happily.

Bonus Contentment Is Short Lived

The promise of a bonus may speed a man up to larger production, but I do not believe that it gives him that contentment of mind and confidence in his employer which is so much needed. My observation has been that a bonus contentment lasts about as long as a bonus does; but the fact that he has a part in determining his work and receives personal recognition, inspires contentment of an entirely different kind. It is, of course, true that a foreman needs to exercise considerable discretion; but if he is incapable of appreciating the human side of his job, an industry is in the long run better off without him.

Industry is the great character builder of today. Men are marred by maladustments. Industrial experiences cover the majority of their waking hours. What is most needed for the development of the individual, for the efficiency of industry and the solution of the problems of the community, is the readjustment of human contacts in plant organization to give opportunity for self-expression.

Every industry should enlist the help of its foremen in promoting activities to help the foreign born worker understand American democracy and identify himself with it. These include such distinct lines of service, as: instruction in English, training in the duties and obligations of citizenship, lectures on American ideals and government, talks on America and its opportunities, picnics, observation trips to study our institutions, folk dances, exhibits of the foreigner's handiwork, advisory boards giving personal interviews to foreigners and health, safety and thrift campaigns.

The whole program is designed to aid the foreign born in taking root in America, and to show him how he can help make safe the house which protects him. In this program agencies like the public school, library, Y. M. C. A. and Y. W. C. A. may co-operate to good advantage.

Surely it is very desirable that all the foreigners in industry should be convinced that their adopted country is one of "freedom, liberty and happiness." Such a conviction inevitably increases industrial efficiency. But this ideal will be realized only when the attitudes and actions of the foremen are fair and right. This involves not only a willingness to promote classes in English and citizenship, but also a real appreciation of the gifts which foreigners bring to America. A new attitude will inevitably breed a new policy of management, which will be wiser, kindlier, fairer than any previously known. The foreman is the key to the whole situation, and can open new doors of understanding to the men under his direction.

The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Further solutions of general involute tooth gear problems—Relation of gear to meshing rack — Duration of contact — Undercutting

THE solution of typical involute gear problems will be continued by the same method as was used in the previous article. The problem is stated, the general solution is deduced by formulas, and a practical problem is worked out.

PROBLEM 10—

Given tooth thickness and pressure angle at radius r_2, to determine position of meshing rack of known proportions and pressure angle.

Referring to Fig. 37, let

r_2 = radius of gear at which tooth thickness is known
T_2 = tooth thickness at r_2
a_2 = pressure angle at r_2
a_1 = pressure angle of rack
r_1 = radius of gear where pressure angle is a_1
T_1 = tooth thickness at r_1
CP = circular pitch of rack
F = nominal addendum of rack, or distance from tip of rack tooth to point where thickness equals one-half the circular pitch
G = distance from center of gear to tip of rack tooth
N = number of teeth in gear.

We know from equation (39) that

$$r_1 = \frac{r_2 \cos a_2}{\cos a_1} \qquad (47)$$

Also from equation (40) that

$$T_1 = 2r_1 \left(\frac{T_2}{2r_2} + \text{inv}\, a_2 - \text{inv}\, a_1 \right)$$

We also know that the thickness of the tooth of the gear added to the thickness of the tooth of the rack where they mesh at the radius r_1 is equal to the circular pitch of the rack, whence

Thickness of rack tooth at $r_1 = CP - T_1$.

Let x = distance of nominal pitch line on rack from r_1, then

$$x = \left[\frac{CP}{2} - (CP - T_1) \right] \frac{\cot a_1}{2} = \left(T_1 - \frac{CP}{2} \right) \frac{\cot a_1}{2}$$

whence $G = r_1 - (F - x) = r_1 - F + x$

Substituting the values of T_1 and x, we get

$$G = r_1 - F + \frac{\cot a_1}{2} \left[2r_1 \left(\frac{T_2}{2r_2} + \text{inv}\, a_2 - \text{inv}\, a_1 \right) - \frac{CP}{2} \right] \qquad (48)$$

Thus to determine the position of a rack of one pressure angle, meshing with a gear whose tooth thickness is known at some other pressure angle, equations (47) and (48) would be solved in the order given. As an example, let

$r_2 = 2.1250$ in.
$T_2 = 0.1700$ in.
$a_2 = 27°—49'—13''$
$a_1 = 20°$
$CP = 0.5236$ in.
$F = 0.1667$ in.

From equation (47) we get

$$r_1 = \frac{2.1250 \times 0.88441}{0.93969} = 2.0000 \text{ in.}$$

From equation (48) we get

$$G = 2.0000 - 0.1667 + 1.37375\ [4.0000\ (0.0400 + 0.042138 - 0.014904) - 0.2618] = 1.8431 \text{ in.}$$

PROBLEM 11—

Given the position of a rack of known proportions meshing with a gear, to determine the thickness of the tooth of the gear.

This problem is the reverse of the preceding one. As we can determine the thickness of tooth at any radius

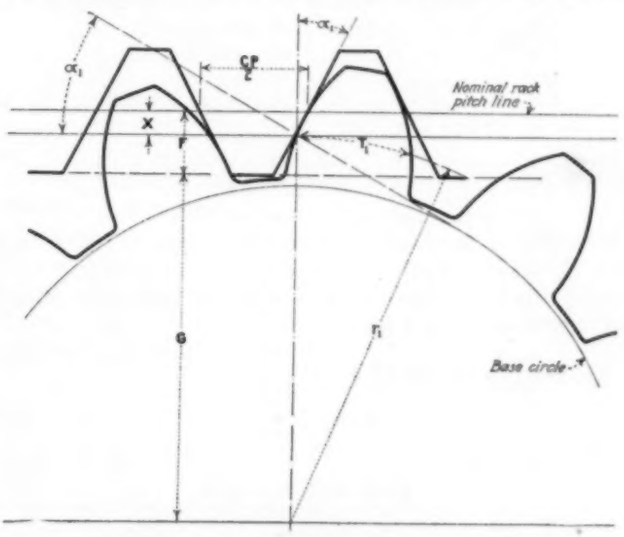


Fig. 37—Determination of the position of the meshing rack with respect to a gear

once the thickness at some specific position is known, in this problem we will determine its thickness where its pressure angle is the same as that of the meshing rack.

The eighth article. The ninth will appear in an early issue.

Referring again to Fig. 37, we have

$$r_1 = \frac{N \cdot CP}{2\pi} \qquad (49)$$

We also have from the previous problem

$$x = G + F - r_1$$

From Fig. 37 we see that

$$T_1 = 2x \tan \alpha_1 + \frac{CP}{2}$$

Substituting the value of x, we have

$$T_1 = 2 \tan \alpha_1 (G + F - r_1) + \frac{CP}{2} \qquad (50)$$

Thus to determine the thickness of the tooth of an involute gear when the position of a meshing rack is known, equations (49) and (50) would be solved in the order given. As an example, let

$\alpha_1 = 20°$
$CP = 0.5236$ in.
$F = 0.1667$ in.
$N = 24$ teeth
$G = 1.8600$ in.

From equation (49) we get

$$r_1 = \frac{24 \times 0.5236}{2 \times 3.1416} = 2.0000 \text{ in.}$$

From equation (50) we get

$$T_1 = 2 \times 0.36397 (1.8600 + 0.1667 - 2.0000) + 0.2618 = 0.2812 \text{ in.}$$

PROBLEM 12—

Given the center distance and pressure angle of a pair of meshing gears, to determine the positions of a meshing rack of different pressure angle.

Let C_2 = center distance between gears with pressure angle of α_2
N = number of teeth in gear
n = number of teeth in pinion
α_2 = pressure angle with center distance C_2
T_2 = tooth thickness of gear at C_2
t_2 = tooth thickness of pinion at C_2
α_1 = pressure angle of rack
C_1 = center distance with pressure angle of α_1
T_1 = tooth thickness of gear at C_1
t_1 = tooth thickness of pinion at C_1
CP = circular pitch of rack
F = nominal addendum of rack
G = distance from center of gear to tip of rack tooth
g = distance from center of pinion to tip of rack tooth.

We have from equation (44)

$$C_1 = \frac{C_2 \cos \alpha_2}{\cos \alpha_1} \qquad (51)$$

We know that

$$T_2 + t_2 = \frac{2\pi C_2}{N + n}$$

$$T_1 + t_1 = 2C_1 \left(\frac{T_2 + t_2}{2C_2} + \text{inv} \alpha_2 - \text{inv} \alpha_1 \right)$$

We also know that the sum of the thicknesses of the rack teeth at the meshing point is equal to

$$2CP - (T_1 + t_1).$$

Let x = sum of distance from meshing point to the nominal pitch line of rack, then

$$x = \left\{ CP - [2CP - (T_1 + t_1)] \right\} \frac{\cot \alpha_1}{2}$$

$$= (T_1 + t_1 - CP) \frac{\cot \alpha_1}{2}$$

whence $(G + g) = C_1 + x - 2F$

Substituting the values of x and $(T_1 + t_1)$ we get

$$(G + g) = C_1 - 2F + \frac{\cot \alpha_1}{2} \left[2C_1 \left(\frac{\pi}{N + n} + \text{inv} \alpha_2 - \text{inv} \alpha_1 \right) - CP \right] \qquad (52)$$

Thus to determine the sum of the rack positions on a pair of mating gears of different pressure angle

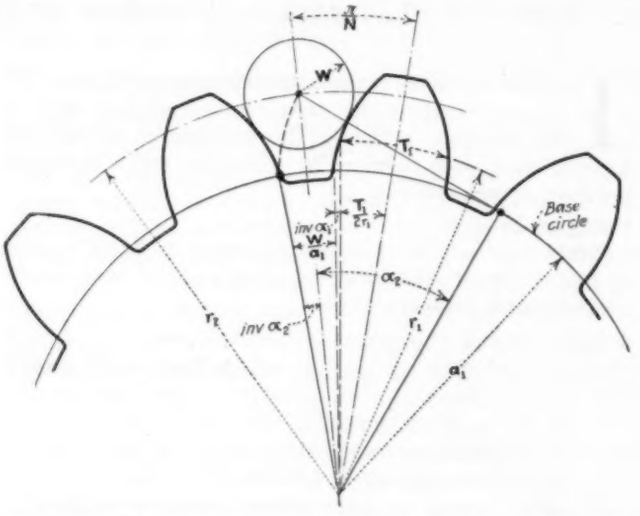


Fig. 38—Determination of the position of a roll in the tooth space

than the rack, equations (51) and (52) would be solved in the order given. As an example, let

$C_2 = 5.1250$ in.
$N = 36$ teeth
$n = 24$ teeth
$\alpha_2 = 23° - 32' - 30''$
$CP = 0.5236$ in.
$F = 0.1667$ in.
$\alpha_1 = 20°$.

From equation (51) we get

$$C_1 = \frac{5.125 \times 0.91667}{0.93969} = 5.0000 \text{ in.}$$

From equation (52) we get

$$(G + g) = 5.0000 - 0.3334 + \frac{2.7475}{2} \left[10 \left(\frac{3.1416}{60} + 0.024798 - 0.014904 \right) - 0.5236 \right] = 4.8025 \text{ in.}$$

PROBLEM 13—

Given tooth thickness of a gear, to determine position of a roll placed in the tooth space.

Referring to Fig. 38, let
a_1 = radius of base circle
r_1 = radius at which tooth thickness is known,
α_2 = pressure angle at r_1
T_1 = tooth thickness at r_1
W = radius of roll
r_1 — radius at which tooth thickness is known,
α_2 = pressure angle at r_2
N = number of teeth in gear.

The distance in circular measure from the center of the tooth to the center of the roll equals π/N.

The distance in circular measure from the center of the tooth to the origin of the involute on the base circle is equal to

$$\frac{T_1}{2r_1} + \text{inv}\,a_1.$$

Another involute is shown in dotted line, which is generated from the same base circle as the involute of the tooth, and which passes through the center of the roll. The distance from the center of the tooth to the origin of this second involute, in circular measure, is equal to

$$\frac{T_1}{2r_1} + \text{inv}\,a_1 + \frac{W}{a_1} \text{ approximately.}$$

The distance in circular measure from the origin of this second involute to the radial line of the gear that passes through the center of the roll is the involute function of a_2, whence

$$\text{inv}\,a_2 = \frac{T_1}{2r_1} + \text{inv}\,a_1 + \frac{W}{a_1} - \frac{\pi}{N} \qquad (53)$$

And from equation (42) we have

$$r_2 = \frac{r_1 \cos a_1}{\cos a_2} \qquad (54)$$

Thus to determine the position of a roll placed between the teeth of an involute gear, equations (53) and (54) would be solved in the order given. As an example, let

$r_1 = 2.0000$ in.
$a_1 = 20°$
$T_1 = 0.2618$ in.
$W = 0.1500$ in.
$N = 24$ teeth.

Then $a_1 = r \cos a_1 = 2.0000 \times 0.93969$

From equation (53) we have

$$\text{inv}\,a_2 = \frac{0.2618}{4.0000} + 0.014904 + \frac{0.1500}{2.0000 \times 0.93969} - \frac{3.1416}{24} = 0.029267$$

From the table of involute functions we get

$a_2 = 24°-48'-43''$

From equation (54) we get

$$r_2 = \frac{2 \times 0.93969}{0.90769} = 2.0705 \text{ in.}$$

In some of the previous articles on the involute curve, many equations were given for determining various conditions on involute gears. The following are repeated here, with definite examples, so as to bring the more important equations needed to calculate involute tooth forms and characteristics together in one place.

PROBLEM 14—

To determine the duration of contact between a pair of mating involute gears.

When a = pressure angle
C = center distance
n = number of teeth in pinion
N = number of teeth in gear
E_1 = outside radius of pinion
E_2 = outside radius of gear
a_1 = radius of base circle of pinion
a_2 = radius of base circle of gear
r = pitch radius of pinion
R = pitch radius of gear
Pn = normal pitch.

Referring to previous articles, from equation (13) we have

$$a_1 = r \cos a \qquad (55)$$

and

$$a_2 = R \cos a \qquad (56)$$

From equation (19) we have

$$Pn = \frac{2\pi a_1}{n} = \frac{2\pi a_2}{N} \qquad (57)$$

And from equation (22) in the fifth article we have: Number of teeth in contact

$$t = \frac{\sqrt{E_1^2 - a_1^2} + \sqrt{E_2^2 - a_2^2} - C \sin a}{Pn} \qquad (58)$$

Thus to determine the duration of contact, or the number of teeth in contact, equations (55), (56), (57) and (58) would be solved in the order given. As an example, let

$a = 20°$
$C = 7.0000$ in.
$n = 30$ teeth
$N = 40$ teeth
$E_1 = 3.2000$ in.
$E_2 = 4.2000$ in.
$r = 3.0000$ in.
$R = 4.0000$ in.

From equation (55) we have

$a_1 = 3.0000 \times 0.93969 = 2.8191$ in.

From equation (56) we have

$a_2 = 4.0000 \times 0.93969 = 3.7588$ in.

From equation (57) we have

$$Pn = \frac{2 \times 3.1416 \times 2.8191}{30} = 0.5904 \text{ in.}$$

And from equation (58) we have

$$\text{Number of teeth in contact} = \frac{\sqrt{(3.200)^2 - (2.8191)^2} + \sqrt{(4.200)^2 - (3.75876)^2} - 7 \times 0.34202}{0.5904} = 1.70 \text{ teeth}$$

PROBLEM 15—

To determine the minimum radius of bottom of space without undercut.

When A = undercut radius
R = radius of pitch circle
a = pressure angle.

From equation (31) in the sixth article we get for a sharp cornered rack

$$A = R \cos^2 a \qquad (59)$$

If the rack has a radius or fillet at the point of the tooth, this rack can extend deeper by an amount equal to the radius of this fillet without developing interference or undercut. Thus, when

f = radius of fillet at tip of rack tooth

$$A = R \cos^2 a - f \qquad (60)$$

As an example, let

$R = 1.0000$ in.
$a = 20°$
$f = 0.0320$ in.

From equation (60) we have

$A = 1.0000 \times (0.93969)^2 - 0.0320 = 0.8510$ in.

PROBLEM 16—

To determine the amount of involute profile removed when cutting below the undercut radius.

When a rack-shaped cutter extends below the under-

cut radius, a portion of the involute profile is removed as the corner of the cutter moves out of engagement. To determine exactly the amount of the involute profile removed would involve very elaborate calculations. The following approximate method* gives results very close to the actual, and slightly greater. It is sufficiently close, however, for all practical purposes.

When A = undercut radius
R = radius of pitch circle
a = radius of base circle
α = pressure angle
f = radius of fillet at point of rack tooth
F = addendum of rack
e = excess depth of cutting, or depth below A
x = radial height above the base circle of involute profile removed.

Then, $$x = \frac{e^3}{6a \sin^2\alpha} \text{ approximately.} \qquad (61)$$

As an example, let

$R = 6.0000$ in.
$\alpha = 14\frac{1}{2}°$
$F = 1.1570$ in.
$f = 0.1570$ in.

From equation (60) we have

$$A = R\cos^2\alpha - f = 5.4669 \text{ in.}$$

Depth of space below pitch circle

$$= 6.0000 - 1.1570 = 4.8340 \text{ in.}$$

$$e = 5.4669 - 4.8430 = 0.6239 \text{ in.}$$
$$a = R\cos\alpha = 6 \times 0.96815 = 5.8089$$

From equation (61) we have

$$x = \frac{e^3}{6a\sin^2\alpha} = \frac{(0.6239)^3}{6(5.8089)(0.25038)^2} = 0.1781 \text{ in.}$$

The radius from the center of the gear to the beginning of the undestroyed involute profile is equal to $a + x$. In this example it is equal to $5.80890 + 0.17813 = 5.98703$ in. In this example there is only about 0.013 in. of useful profile below the pitch circle.

This equation can be simplified for use with definite pressure angles by substituting the corresponding values for the specified pressure angles.

For $14\frac{1}{2}$ deg. this would become:

$$x = \frac{2.7448e^3}{R} \qquad (62)$$

For 15 deg. this would become:

$$x = \frac{2.5758e^3}{R} \qquad (63)$$

For $17\frac{1}{2}$ deg. this would become:

$$x = \frac{1.9327e^3}{R} \qquad (64)$$

For 20 deg. this would become:

$$x = \frac{1.5158e^3}{R} \qquad (65)$$

For $22\frac{1}{2}$ deg. this would become:

$$x = \frac{1.2320e^3}{R} \qquad (66)$$

*By Ernest Wildhaber, of the Gleason Works, Rochester, N. Y.

Aluminum pistons can be turned at from 400 to 500 ft. per min. with a feed of 0.025 per revolution and a cut of $\frac{1}{8}$ in. The tool should have both top and side rakes of about fifteen degrees. The point can be rounded slightly and should have only a slight clearance below the cutting edge; five degrees is plenty.

Seen and Heard

BY JOHN R. GODFREY

Tradition and the oil can

IN DISCUSSING business in London with a British manufacturer some years ago, he bemoaned the fact that, being young, we in the U. S. had no traditions. I told him that I considered it an advantage and only feared that we would get them all too soon. And in some lines of modern work we've got 'em already.

A good example is in the lubrication of machinery. The oil hole and the squirt can gradually gave way to the oil cup and in a number of cases it still sticks at that particular point. Sight feed cups are found in some modern machines—dozens of them it seems, and in too many cases they are empty when I go by. And an empty oil cup isn't a lot of help in securing easy running bearings.

Some enterprising machine builders began by using flooded lubrication on such parts as could go inside the column of the machine or in the head. A pump in the base forced the oil to the top and let it run down into the bearings and over the gears. In other cases the gears carried the oil up to shafts and bearings.

But there are many bearings that cannot be reached in this way and we still find a lot of oil cups, some in out of the way places. Then we have central oiling systems with reservoirs and pipes running off like a pneumatic tube conveyor in a department store.

The automobile builders started out with the open oil hole abomination but soon covered the holes with all sorts of tricky covers that kept out at least part of the dirt. Then followed the grease cups, also copied from other machinery builders. But, being new they had no tradition, and the next thing we knew there was the pressure lubricating system using grease as a lubricant and a screw gun. In this way the bearings can be reached by pipes running to all inaccessible points and the bearings oiled without being more or less of a gymnast and getting a nice clean set of overalls all goo-ed up the first thing in the morning.

Next came the use of oil instead of grease and guns that didn't have to be twisted. Both of these methods are now used by builders of machines of various kinds.

But the automobile designer didn't stop there. He designed a one-shot system that forced oil to every bearing in the chassis when the driver pushed a plunger. And he fixed this device so it could be operated from the seat, using the heel of the brogan, or of the low-and-behold slipper, depending on which kind of a driver it was. There are now various kinds of these devices.

In some cars the oil is shot straight to the bearings and washes out the old oil, as well as drips out of the bearings if you shoot too much. In other cars the pump is used to fill a reservoir at the bearings, a wick being used to feed the oil. One car has a sort of metering pin with varying clearances around it to suit the amount of oil needed at each bearing. But the engineers are trying some way to get oil where it belongs without the uncertainty of the oil can or gun.

Is there any reason why the one-shot idea can't be used on a lot of machines that now suffer from lack of lubrication of bearings not easily reached?

The Division of Labor in Tool Manufacture

By G. A. Pennock
Technical Superintendent, Hawthorne Works, Western Electric Co.

Waste of time, effort, and material is reduced by specialization—Planning to determine type of tool—Standardizing tool parts—Subdividing the machine and bench work—Comparative results

THE main contributing factor in the elimination of waste in the toolroom has been the division of labor to bring about less dependence upon the all-around craftsman skilled in all phases of tool making, and the development of specialists in various machine and bench operations. This division of labor is exemplified in the telephone plant of the Western Electric Co., where tools must be provided and maintained for the manufacture of 110,000 different parts that are assembled into 13,000 separate pieces of apparatus. These parts are not only made of metals, but also of glass, porcelain, fiber, soft and hard rubber, paper, and insulating materials.

> Without specialization it would be difficult or impossible today to obtain the great number of highly skilled all-around toolmakers that would be required to produce fast enough the many complicated tools required by the large manufacturers

The work is in general very accurate, and requires a great variety of tools and dies, intricate fixtures, and gages. As a consequence, the Hawthorne Plant of the Western Electric Co. has $12,000,000 invested in tools, and $1,000,000 in toolroom equipment, with a force of 600 toolmakers at work. During 1925 the toolroom manufactured 4,400 major new tools besides nearly half a million dollars worth of small tools such as reamers, taps, and milling cutters. In addition, 30,000 tools were repaired during the year. The new tools ranged in cost up to $12,000 for one punch and die.

Thirty years ago, when the Hawthorne Plant had only 15 toolmakers, each one was an all-around craftsman capable of handling any job that came along, from the planning to the finished fitting. Today the plant has 10 general types of employees engaged in tool manufacture including planners, designers, and separate operators for various classes of machine and bench work.

Instead of leaving it to the toolmaker, the planning organization now determines the kind and type of tool to be made, based upon the annual demand for the part. If, for example, the annual requirements of a small part are 10,000 or less, the simplest tools are ordered. But if the requirements are as high as 1,000,000 a year, more efficient and higher priced tools are requested. For a still larger annual output only the most efficient tools are considered, such as multiple compound dies and multiple forming tools, tools combining two or more operations and equipped with dial or hopper feeds.

The tool designing division is divided into four departments: The punch and die department; the jig and fixture department; the gage department; and the screw machine tool department. The designers in each of these groups work almost entirely upon one particular type of tool, resulting in a more efficient design and lower design cost. With our large requirements, standardizing of tool parts was an obvious step, and as a consequence the tool design division has compiled a very complete set of standards. These standards cover such items as punch and die holders, sub press frames, die blocks, liner pins and bushings, dowel pins, automatic stops, springs, and screws.

Standard tool designs eliminate the necessity of making a complete tool design for each tool. In the case of a standard punch and die all the drawing necessary is a layout showing the part to be made, which, together with a designation of the standard parts, is all the information required by the toolroom to complete the tool. The standard parts to be used are shown on the tool layout designated by the number under which they are stocked. These standards have given us quantity production of parts, insure adherence to practices which experience has proved to be the best, and have cut the cost of the tool drawing to a minimum.

From the tool design division, the tool order, together with drawings, goes to the tool ordering organization. This section checks the estimated cost of the tool, orders standard commercial parts, places orders for patterns, castings, or forgings, and follows these orders to insure delivery to the toolroom. It also writes up the order, giving the complete description of tool and part to be made, a final estimated tool cost, and forwards the whole to the shop with the drawings.

Specialization of work, or division of labor, is car-

Abstract of paper presented at the meeting of the Chicago Section, A.S.M.E., Mar. 24, 1926.

ried to a greater degree in the tool shop than in the tool design division. The toolroom is divided into the following main groups: Milling machine section; lathe section; grinding section; and bench work section. These main groups are still further subdivided. In the lathe section there are specialists on threading plug gages and master taps, and still others who turn only circular form tools. The bench work section is subdivided into punch and die work, gage work, and general tool work, which includes drill jigs, assembling and milling fixtures, and screw machine tools. In the die gang of this section there are compound die makers, tandem die makers, and forming die makers, who perform only the bench work necessary in the building of these dies.

Every order for a tool is scheduled and routed through the various sections of the toolroom. In this manner, every operation is carried out by a man so skilled in his own particular work that a minimum amount of time is required in setting up work, and greater speed and accuracy assured. Upon the completion of the tool it is routed to the tool inspection organization. Not only must the part be produced according to the drawing, but it must be correct for subsequent operations, and where practical, all tools are given a trial run under shop conditions before they are released for use in the shop. In most cases a man on tool inspection is employed constantly on the type of tool on which he has specialized, with a resulting high grade of work at a lower cost.

Under the old method of highly skilled operators much time was lost in setting up and waiting for tools and machines. By specialization and planning the amount of floor space and equipment to do a given volume of work has been reduced. To work under the old method it is estimated that the Hawthorne plant would need 800 highly skilled all-around toolmakers, which would be impossible to get if other industries were making similar demands. Under the specialized system another advantage is the fact that more accurate and more complicated work is possible because of the high degree of skill attained by each specialist.

The alleged disadvantage often cited against specialization, that it is monotonous and killing to initiative, is not found true. Specialization actually raises the type of work that the average or the mediocre man can handle, and with such a variety of work, men with initiative and ability have many opportunities for advancement. Success at one class of work means promotion to the higher grades, and there will always be need for numbers of highly skilled all-around men at top wages. The shop hand with design ability, or with an analytical mind, finds openings in the design or planning work, and thence into executive positions. Many of the Hawthorne executives of today have traveled this road. For the average man who finds one class of work more pleasing or adaptable, specialization allows him to command a maximum return in wages, and is undoubtedly one of the outstanding reasons for the general prosperity of the country today.

Reclamation on the Santa Fe

By Robt. K. Graham
General Superintendent, Corwith Reclamation Plant, Atchison, Topeka & Santa Fe Railroad

RECLAMATION, or salvage of material, as the word is used on the Santa Fe Railroad, means to restore to use any material that has been previously condemned and scrapped by the department formerly using it, or considered no longer serviceable. Reclamation of condemned material was unrecognized with most of the railroads of the country until within the last fifteen years. It was much easier to discard a worn or broken tool, or a dismantled piece of material, and apply to the storekeeper for new, than to attempt to repair it or find other use for it. The Santa Fe was the first railroad to inaugurate regular railroad reclamation work when it started a yard at Corwith, Chicago, for the reception and assortment of all scrapped material.

In 1909, what was known as the Santa Fe Corwith Scrap Yard had one 10-ft. x 12-ft. shanty as an office, one box-car body for a blacksmith shop, and had one blacksmith and one helper. At present the shops and storehouse cover three docks, and an additional floor space of ten acres, housing about $300,000 worth of machinery. During the year 1925 there were reclaimed from scrap, 8,686 tons of material that went through the shops, and 914 tons that were shipped back on the line without needing repairs.

In the ordinary course of assortment of all kinds of scrap that came to the scrap yards, it was discovered that a considerable portion of the scrap was fit for use, without any repair work whatever. All of these parts were put back into service as new material. This was clearly reclamation work. It was also found that a great deal of the condemned material could be made as serviceable as new with very little repair, or with small expense could be made over for other uses.

In addition to salvaging from the scrap heap, efforts were made to decrease the volume of scrapped material. All employees were instructed to continue material in use as long as it would be safe, and a marked decrease in the volume of condemned material was at once noted.

The Santa Fe reclaims track jacks, switch stands, tamping picks, angle cocks, switch chains, nuts, bolts, spikes, track shovels, and many other articles. The saving for the blacksmith shop alone during 1925 was $73,247, and the net saving in all departments was $322,540. The net saving on material sorted from scrap that did not need repairs was $72,727. In one year there were repunched about three million tie plates.

The Corwith plant has in operation two rolling mills, one 22-in. 3-stand bar mill, and a 12-in. roughing, with a 9-in. finishing mill. During 1925, working 175 days, there were turned out 11,277,800 lb. of finished steel in all sizes from $\frac{1}{4}$ in. to 2-in. rounds, and $\frac{1}{2}$-in. x $\frac{1}{8}$-in. flats, up to 1-in. x 10-in. flats. The net saving on this steel was $36,561 for the year.

Accurate records are kept of all salvage. In its progress through the shop the material is charged with the scrap value at selling price, the labor cost, new material used, and a proportion of overhead expense. Actual profits are obtained as nearly as possible. The control of the salvage work is under the purchasing department, the salvage plant being a part of its organization.

Abstract of paper presented at the meeting of the Chicago Section, A.S.M.E., Mar. 24, 1926.

Accurate Angles by Optical Methods

By Frank C. Hudson

A simple and very accurate method of setting work at right angles, that can be used on any toolroom job

OPTICAL instruments that depend upon reflection require that the mirrors be set very accurately at the desired angles. Such a problem came up in the shop of the Pioneer Instrument Co., Brooklyn, N. Y., in connection with a new instrument and in order to secure extreme accuracy optical methods were very appropriately employed by Victor Carbonara, the expert in charge of that class of work.

While the shop has an excellent equipment for the work to be done, no milling machine vise can be depended on to give extreme accuracy in swiveling the base to a very accurate angle. So an old machine was used and the question of accuracy eliminated from the machine itself, except that the table travel was checked and found to be square with the spindle.

The problem was to cut the two ends of a piece of aluminum tube at 45 deg. with the axis, and consequently at 90 deg. from each other, within very close limits. So a glass prism with a face 45 deg. to the two edges was selected for the work. First a light brass stand was made to hold the glass prism in position on the vise, a finger spring holding it in place while being used, and to fold down out of the way when the prism was removed to permit the cut to be made.

A telescope was temporarily mounted on a tripod with the cross hair in a vertical position. The piece of tube was clamped in the vise, and lined up parallel with the ways of the table slide with a precision indicator. The stand carrying the prism *A* was mounted on the vise and held by the spring, and the telescope was sighted as in Fig. 1. A convenient window allowed the reflection of the corner of a brick building about 300 ft. away in the long side of the prism. The telescope was then adjusted until the vertical cross hair matched the building line.

Then the vise was swiveled as in Fig. 2 until one of the 45-deg. sides of the prism showed the same reflection in line with the cross hair of the telescope, the vise clamped and the tube cut. Swinging the vise the other way, Fig. 3, allowed the same reflection to be picked up on the opposite surface of the prism, and the other angle was cut. This method of using the reflection of a distant object, gives very accurate settings and can be used to advantage in fine toolroom jobs where accuracy is the prime object. The angular faces of the glass prism were used solely as mirrors and not to refract the light.

In Figs. 2 and 3 the prism holder can be seen, held in place by the spring *A*. Fig. 4 shows the prism removed

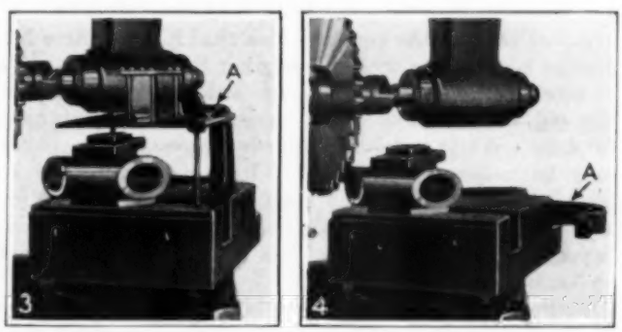


Fig. 3—Set for the second cut. Fig. 4—Prism removed for cutting

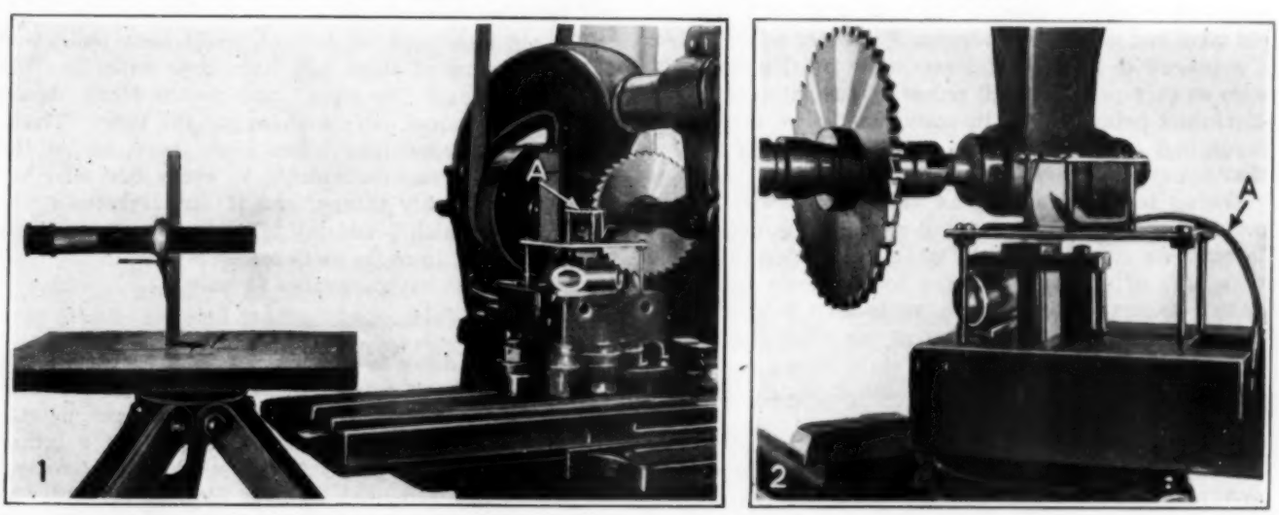


Fig. 1—Prism and telescope set up. Fig. 2—Ready for the first cut

and the spring *A* turned down out of the way of the milling cutter. The lower part of the prism holder is simply a stand to raise the prism to approximately the center of the spindle.

Utilizing the same method, the work could be checked by fastening plain reflecting mirrors of uniform thickness, on the angles after cutting and testing the reflection in the same way. The different views show the apparatus and the way in which it was used.

Those New Superintendents—Discussion

By F. T. Terry
Belfast, Ireland

THE contribution by J. E. Dykstra, under the title given above, on page 845, Vol. 63, *American Machinist*, is of such a nature that all who are, or hope to be, superintendents, should give it their most careful attention.

All old readers of this journal can recall men of the type so well portrayed by your contributor as "Modernists," who have been complete failures, and have fixed the blame upon anything but the real cause—their own lack of common sense. Some of us may also be thankful that we have been able to avoid similar errors, since it is so easy to make a slip and the new superintendent is forever damned, and moves on, the shop he was to reform knowing him no more.

Changes Often Necessary

I have found from experience that the "Modernist's" greatest fault is the common idea that his new firm has always been losing money, and that he alone is capable of steering the ship into smooth waters without any of the old crew, or even the owners, being called upon for help. While it does sometimes happen that a change may be necessary, because of loss, it will usually be found that other reasons such as death or promotion are the principal causes for a change, and all that is expected of the new "super" is to keep going forward as smoothly as possible.

Some twenty-five years ago, and about the time that the name "superintendent" became more popular than the old term of "manager," the writer held the position of machine shop foreman with a very old firm that always made money, despite old tools and old ways and old men, but with the *American Machinist* as my Bible, I managed to replace at least many of the old tools. Also at that period we all talked system, the *American Machinist* being full of it, consequently we introduced cards and duplicates and every other form of system that appeared favorable.

Owing to the death of an old partner who always considered himself the manager, the firm decided to introduce a superintendent (which many thought would be a sort of policeman, owing to the name being unknown except in connection with this force). This position, which was thrust upon me after the failure of two "Modernists," I held for eight happy years, and no doubt benefited from their failures which for crass stupidity would be hard to beat.

The first "Modernist" did not appear at all obnoxious but like everyone, myself included, believed in system, and forms, signed and countersigned, but as we had already introduced about all we could of them, he found it difficult to get ahead and the only form he brought out was a duplicate book with each tear-out page headed, "To the General Works Superintendent" and we were informed that when we wanted anything or should anything out of the ordinary happen, we were to send along a note on one of the pages and it would keep him right, and the rest of us would consequently find ourselves in the same happy position. Naturally the prefix "General" upon his forms brought about the immediate title of "Field-Marshal" from the youngest office boy up, but everyone was quite ready to do all possible to help him along.

Two or three days later the "Field-Marshal" was in my office enjoying a friendly chat, when an office boy hunched in with a memorandum which informed him "that some valves urgently required might be in at any time" and was initialed W. H. After reading this the "Field-Marshal" wrote across it with my red ink, "Who is W. H.?—please sign full name," telling the boy to take it back where it came from. That memorandum never came back, but a few minutes later "Old Willie" the secretary was telling me that every bank in the country knew those initials and so would the "Field-Marshal" next time he saw them. At the end of the month the F.-M. received a substantial check together with a request to resign which bore the initials W. H.

A Hasty Exit

The second "Modernist" only lasted a day and a half. At the end of the first day he fired six of the oldest hands, presenting each with a week's wages as a parting gift. In the morning, before midday, he was requested to call upon "the old man" and what happened remains a mystery, as he never appeared in the works again, but the six old hands were back the next day, and before the end of the week I was in the position to send along to the cashier a memorandum instructing him to pay these men another week's wages, which, known only to myself, had the sanction of the "old man," who was highly delighted at my suggestion of recompensing these old veterans.

In both these instances fatal mistakes were made which could easily have been avoided, and in any case could do no good to anyone. The initials W. H. might have been the proprietor's, in fact, it would have been better for the F.-M. if they had, instead of belonging to the old secretary, who although quite willing to help anyone, had done pretty well as he liked for forty years, and intended to continue.

The old men paid off had no doubt seen their best days, but some of them had been boys with the "old man," who "paid the piper," and whose views should have been obtained before changing the tune. These, and similar happenings have, I am sure, ended the careers of ten superintendents to every one who has fallen over the big things, and if Mr. Dykstra's contribution to which I add my mite, saves only one new superintendent from the self-created pitfalls of the position, it will not have appeared in vain.

To prevent delay in picking out fixtures for various work, many shops paint them with different colors as distinguishing marks. For example, fixtures painted blue might be for milling machines, red for lathes, green for planers, etc. On the other hand some shops use colors to distinguish tools or fixtures for different customers.

Inertia Forces in the Geneva Stop and Similar Mechanisms

By James A. Hall
Professor of Mechanical Engineering, Brown University

Derivation of the equations for acceleration and inertia forces for the general case of crank and slotted-arm mechanisms—Practical example worked out

THE GENEVA movement as used in indexing devices for automatic machinery is a particularly interesting form of mechanism as it lends itself readily to exact mathematical analysis. The equations used in this analysis are of much broader application, however, as they apply equally well to any mechanism where a crank of constant length, rotating at constant speed, drives a second arm or rotating part with variable velocity by means of a slot, the center line of which passes through the center of rotation of this member. Common examples, in addition to the Geneva stop mechanism, are the swinging-block, quick-return motion frequently found in pillar shapers, and the Whitworth quick-return mechanism where the follower makes one complete revolution for each revolution of the driving crank.

The study of these mechanisms in the past has been largely confined to velocity analysis, but the present demand for greater speed of operation is making the determination of accelerations and inertia forces a problem of prime importance. This article is also timely as the *American Machinist* has recently published two articles* on the Geneva stop mechanism, both of which failed to give the complete analysis and, in addition, included errors either in idea or in application.

In Figs. 1, 2, and 3 are shown in diagrammatic form the three types of mechanisms mentioned above. In each of these illustrations the constant-velocity crank has a radius R and the distance L between the centers of rotation of the driver and the follower is given as a constant times the crank radius, or CR.

All of these cases can be represented by the diagram shown in Fig. 4. The position of the crank is given by the co-ordinates x and y with reference to the line of centers as the horizontal axis and to a vertical axis through the center of rotation of the variable velocity arm. The angles made by the constant-velocity crank and the variable-velocity arm with the line of centers are θ and ϕ respectively. The relation between these two angles is given by the equation:

$$\phi = \tan^{-1}\frac{y}{x} = \tan^{-1}\frac{R\sin\theta}{CR - R\cos\theta} = \tan^{-1}\frac{\sin\theta}{C - \cos\theta} \qquad (1)$$

The angular velocity of the variable-velocity arm can be determined by differentiating ϕ with reference to time. As θ is the angle made by the constant-velocity crank, we can represent it by a constant multiplied by the time in seconds, or kt, where k is the angular velocity of this crank in radians per second. Since there are 2π radians in each revolution, one can easily figure k for any given case. The angular velocity ω of the driven arm in radians per second for any value of the angle kt, or θ, is given by the equation,

$$\omega = \frac{d\phi}{dt} = \frac{k(C\cos kt - 1)}{1 + C^2 - 2C\cos kt} \qquad (2)$$

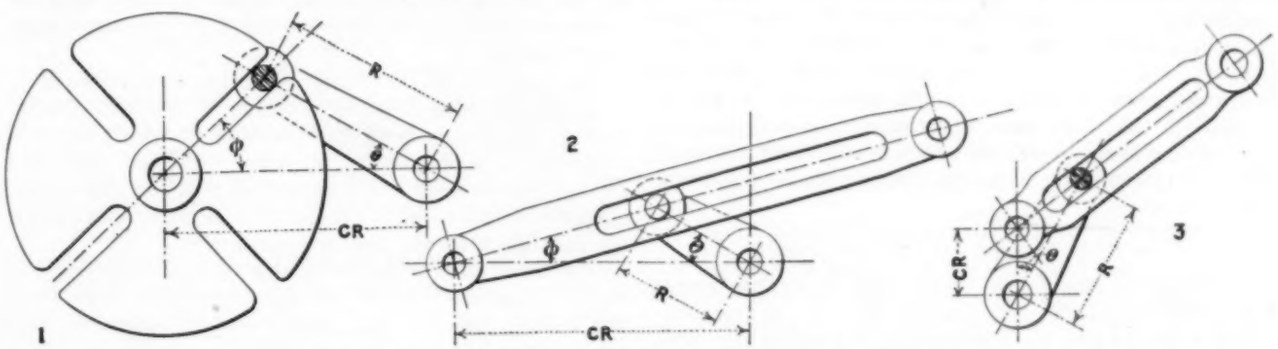


Fig. 1—Typical example of the Geneva stop mechanism. Fig. 2—Swinging-block, quick-return mechanism Fig. 3—Whitworth quick-return mechanism

*"Indexing Mechanisms for Automatic Machinery," by C. S. Seltzer, Vol. 63, page 15, *American Machinist*. "Some Characteristics of the Geneva Movement," by Bernard M. Fine, Vol. 63, page 913, *American Machinist*.

The angular acceleration a of the variable-velocity arm is given by the equation,

$$a = \frac{d\omega}{dt} = \frac{k^2C \sin kt(1 - C^2)}{(1 + C^2 - 2C\cos kt)^2} \quad (3)$$

To determine the amount of the acceleration at any desired position of the constant-velocity crank, the corresponding value of θ can be substituted for kt in the above equation.

As the torque on this arm is a direct function of the acceleration, the maximum value of the latter is of particular importance. The position where this occurs can be determined by differentiating a with respect to t and putting the answer equal to zero. This gives

$$kt = \theta = \cos^{-1}\left[\frac{-1 - C^2 \pm \sqrt{1 + 34C^2 + C^4}}{4C}\right] \quad (4)$$

In other words the acceleration is a maximum at that position of the constant-velocity crank where the cosine of θ has the value given in the brackets.

To determine the maximum value of the acceleration in any given case, it is first necessary to find the position of maximum acceleration from equation (4) and then to substitute this value of kt in equation (3).

The torque T on the variable-velocity arm, due to the inertia of the parts, is equal to the product of the acceleration and the moment of inertia I of the parts being accelerated. This is given by the equation,

$$T = Ia = \frac{Ik^2C \sin kt(1 - C^2)}{(1 + C^2 - 2C\cos kt)^2} \quad (5)$$

If k is given in radians per sec. per sec., and I is in units of pounds weight multiplied by feet squared and divided by 32.2, the answer T will be in foot-pounds.

The analysis of mechanisms of this class is rarely carried beyond the results given by the above equations and graphical methods are generally used in determining the velocities and accelerations. If great care is used in plotting, the acceleration can be found with reasonable accuracy from the slope of the velocity-time diagram. Direct graphical determination of the acceleration will give more accurate results, but the principles involved and the technique required in mechanisms of this type are rarely taken up in books on engineering mechanics and are not described here, as most designers will find the mathematical equations easier to use.

Forces Acting on the Driving Shaft

In designing machinery to take care of inertia forces, the knowledge of the torque on the driving, or constant-velocity shaft, and the pressure on the crank pin may be of much more importance than any of the figures given by equations (1) to (5). Furthermore, graphical methods cannot easily be applied to the determination of these additional quantities, so that recourse to mathematical analysis is almost essential as well as relatively simple.

Referring to Fig. 4, the pressure on pin p acts at right angles to the arm and can be determined by dividing T of equation (5) by op. This gives as the amount of the pin pressure P for any given value of the angle θ, or kt,

$$P = \frac{Ik^2C \sin kt(1 - C^2)}{R(1 + C^2 - 2C\cos kt)^2} \quad (6)$$

This, of course, gives the pressure due to the inertia of the parts alone and must be increased for friction and for any forces caused by work being done. Crank length R is in feet.

The maximum amount of P can be determined by first finding the position of the crank giving this value just as was done in the case of acceleration. This gives

$$kt = \theta = \cos^{-1}\left[\frac{-1 - C^2 \pm \sqrt{1 + 62C^2 + C^4}}{6C}\right] \quad (7)$$

That is, the pressure on the crank pin due to the inertia of the parts is a maximum when the figure for the cosine of θ is the amount given in the brackets.

The torque on the driving shaft can be determined by making the energy input equal the energy output, that is, the torque on the driving shaft T_1 times its

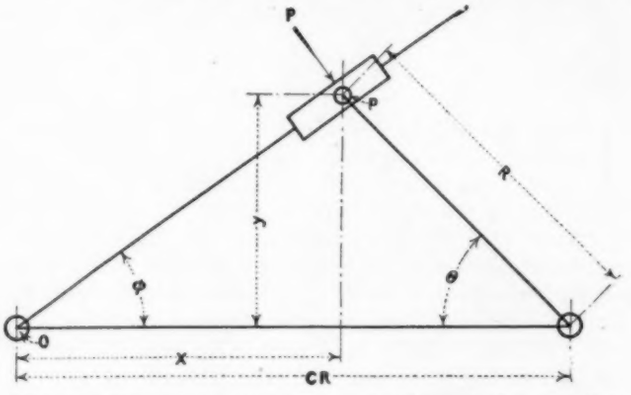


Fig. 4—Diagrammatic representation of the general case of crank and slotted-arm mechanisms

velocity k must equal the torque on the driven shaft as given by equation (5) multiplied by its velocity as given by equation (2). This gives

$$T_1 = \frac{Ik^3C \sin kt(1 - C^2)(C\cos kt - 1)}{(1 + C^2 - 2C\cos kt)^2} \quad (8)$$

The above equation can be used to determine the torque on the constant-velocity crank shaft for any angular position θ, or kt, of the crank while it is in contact with the follower.

The position of the crank when the above torque is a maximum is not easily determined mathematically. It will occur very near the position at which the pin pressure is a maximum, so that the "cut and try" method can be used, starting at this position and taking successive values of θ one or two degrees apart until the maximum torque has been passed.

The term kt may be confusing to some readers, but no error in the use of the equations will arise from the substitution of the angle θ for kt, wherever this term occurs.

Illustrative Example

Many readers may find the derivation of the above equations somewhat difficult, but their use in the solution of actual problems is comparatively simple. In most cases results of sufficient accuracy can be secured with a slide rule, but C^2 and $2C\cos\theta$ in the parenthesis $(1 + C^2 - 2C\cos\theta)$ should be determined by multiplying out, or by using six-place logarithm tables, because small variations in these figures will make a large difference in the answer.

As an illustration of the use of the equations, the analysis of a turret operated by a Geneva stop mechanism is given below. This turret has a moment of inertia of one unit and is indexed one-quarter of a

turn by a crank running at 60 r.p.m. This makes the velocity of this shaft 2π radians per sec. The constant-velocity crank has a radius of 6 inches. The crank pin enters the slot in the turret radially so as to eliminate shock. The angle θ (see Fig. 4) will be 45 deg. when the angle ϕ equals 45 deg. and this requires that the distance between the two centers be 8.484 in. The value of C comes out 1.414.

Summarized:

$I = 1$ unit, ft.-lb. sec.^{2}
$k = 6.283$ radians per sec.
$R = 0.5$ ft.
$C = 1.414$

Substituting this value of C in equation (4), we get

$$kt = \theta = \cos^{-1} 0.98006$$
$$= 11^\circ 28'$$

Acceleration of the turret is a maximum when the crank makes an angle with the line of centers of 11 deg. and 28 min. Inserting this value of θ, or kt, in equation (3) the maximum acceleration is found to be

$$a = 5.4k^2$$
$$= 213.5 \text{ radians per sec. per sec.}$$

The torque necessary to cause this acceleration is given by equation (5) as follows:

$$T = 213.5 \times 1 = 213.5 \text{ ft.-lb.}$$
$$= 2562 \text{ in.-lb.}$$

If the turret and the indexing disk were connected by a shaft on which both of them were mounted, the

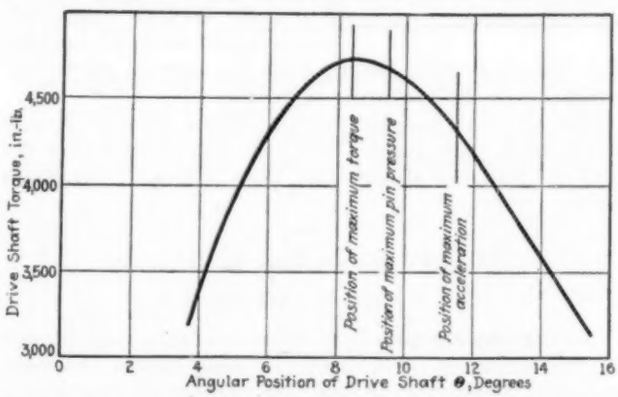


Fig. 5—Curve showing variations in drive crank torque during rotation

above torque would act on this connecting shaft. It would not be the torque exerted on the driving shaft.

To determine the forces acting on the driving shaft, it is desirable to first calculate the maximum pressure on the crank pin p. Substitute the value of C in equation (7); the crank position for this maximum pin pressure is then determined as follows:

$$\theta = kt = \cos^{-1} 0.98615$$
$$= 9^\circ 33'$$

The amount of the pin pressure is found by inserting this angle θ, or kt, in equation (6). Thus

$$P = 11.5k^2 \frac{I}{R}$$
$$= 908 \text{ lb.}$$

The torque on the constant drive shaft is very near its maximum at the point where the pin pressure has its greatest value. The value of the angle kt derived in the preceding paragraph is therefore substituted in equation (8), giving the following result:

$$T_1 = 9.85Ik^2$$
$$= 389 \text{ ft.-lb.}$$
$$= 4668 \text{ in.-lb.}$$

To see if the actual maximum of this torque is much greater than the above value, equation (6) is solved for a number of positions of the crank on each side of the point of maximum pin pressure. These results are plotted in Fig. 5.

It is interesting to note from this curve that the torque on the driving shaft is only a little over one per cent greater at its maximum position than at the point of greatest pin pressure. The torque at the point of greatest acceleration of the turret, however, is about 8 per cent below the maximum.

The analysis of the inertia forces in this mechanism furnishes the following data for use in design.

Maximum torque acting on turret = 2562 in.-lb.
Maximum torque acting on drive shaft = 4725 in.-lb.
Maximum pressure acting on crank pin = 901 lb.

It should be noted that the above figures are for inertia forces only and that they must be increased to take care of friction and other forces acting at the time of acceleration. In any mechanism which is running at a speed great enough to require an analysis like the one given, the frictional forces will be very small compared to the inertia forces, so that a rough approximation of the former will be sufficient. As a rule, the only other force will be the weight of the parts, and this can be readily determined. In the shaper the tool is not cutting metal when the swinging arm is near the position of maximum acceleration as this occurs on the return stroke. The maximum inertia forces can, therefore, be determined and then compared with the estimated forces during cutting combined with the smaller inertia forces existing during this period.

The time-honored practice of proportioning machine parts so that they look strong enough to the experienced designer and of increasing the size, if they fail to function properly, arose from the fact that the forces to be overcome were unknown or, at best, could only be roughly approximated. This practice is likely to lead to trouble in variable speed mechanisms, so that it is particularly fortunate that inertia forces lend themselves readily to exact mathematical investigation. Just as the inertia forces caused by the pistons, valves and connecting rods of automobile engines are now carefully investigated, methods of analysis such as that given above will come into greater use with increased speeds of automatic and semi-automatic machinery.

Research Projects of the A.S.M.E.

After careful consideration the main Research Committee of the American Society of Mechanical Engineers has decided to sponsor the formation of six additional special research committees, of which there are now twelve with a total enrollment of 140 members. These new projects will cover the subjects of saws, cutting edges (thin metal plates), grinding wheels and grinding, fuel oil spray characteristics (in co-operation with Pennsylvania State College), spark arresters for logging locomotives and donkey engines, and radiation of furnace gases. Suggestions for other major research problems will be solicited from various engineering colleges, experiment stations, large industries and trade associations. Any ideas obtained from these sources will be thoroughly studied and listed.

These special committees will not actually carry on the researches, but instead will encourage the study of the given subject and will act as fiscal agents in the collection and disbursement of funds.

Ideas from Practical Men

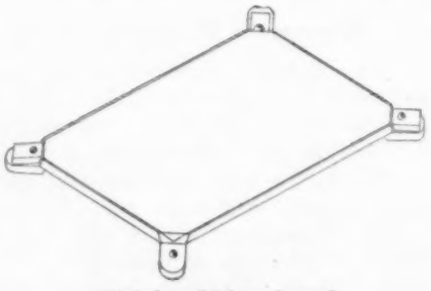
Cast-Iron Plates for Holding Abrasive Cloth

By Donald A. Hampson

In all machine shops that do light manufacturing it is a common practice to rub small parts over a piece of abrasive cloth laid flat on the bench, either for cleaning or polishing or burring. There are numerous jobs of this kind for which a sheet of abrasive cloth is more satisfactory than a file, and where the work is done continuously it is customary to have boards about a foot square to which the cloth is tacked at the corners.

An examination of the "abrasive boards" in any shop will show them to be in poor shape, so far as presenting a true plane as a basis for rubbing upon is concerned. The boards may have been well made in the first place or they may have been pieces sawed from an odd piece of packing lumber, and in the latter case their condition is liable to be highly inaccurate. And upon such boards the operator tries to remove a uniform amount of metal from a flat work piece, or to produce a polish all over the true plane of a metal part, handicapped by a sheet of abrasive cloth that is oil soaked and has pulled loose from its tacks at one or more corners.

One manufacturing shop has put this class of work upon a better basis by making cast iron "abrasive boards" to be issued just as are files. These boards are light castings having a face 9x11 in., planed true but not real smooth, the finish being done with a round pointed tool given a ⅛-in. feed, and the cut being taken at right angles to the longer dimension. Finished in this way, the cloth has a better grip on its face and it is believed that the cutting qualities of its working side are more fully utilized.



Metal rubbing board

The illustration shows that the corners are cut off at a 45-deg. angle and given a 30-deg. bevel. Under the corners, lugs project that act as feet for the "board," to raise it at a convenient height from the bench, and that serve to hold the screws that clamp the cloth. Each foot is tapped, and flat-head screws are used in connection with steel clamps, beveled on one end to correspond with the bevel on each corner of the "board."

Then, instead of trusting to skill to tack each new sheet of cloth on the wooden board (and rarely doing a good job), the operator who has one of these metal "boards" merely loosens the four corner screws, slips the corners of the cloth under the clamps, and tightens the screws again. His cloth is taut and it is not punctured with trial holes. Should it stretch a little in using, it may have the puckered spot drawn out without trouble. And there are no tack heads in the way of using the entire surface.

Placed at the right height, the wooden boards are fast producers where final fitting, or jobs that require appearance rather than accuracy are done, but they have never ranked very high mechanically, because the uneven surfaces and the baggy abrasive have not been conducive to good work — inaccurate surfaces, rounded corners and blotchy finishes having been the natural characteristics due to the mounting methods.

Use of iron "boards" has raised the quality of such bench work very much. The cost of the work and the cost of changing sheets have been reduced proportionately.

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit.

"Hand" Reaming by Power

By Milton Wright

Among the operations in the manufacture of Singer sewing-machines there are many that involve the line-reaming of the bearing holes for the several shafts that go to make up the mechanism. Since these shafts revolve at a very high speed when the machine is in service, it is highly essential that the holes be in alignment, and therefore the line-reamer, turned by hand, is the tool usually adopted to finish them.

A line-reamer is strictly a finishing tool and is expected to remove but a minute quantity of stock, hence to manipulate it by hand is not particularly arduous, even though the tool may be cutting upon several shoulders at once, but when the operation involves the use of ten or more reamers to each machine bed, and when, moreover, the number of beds to be reamed in a day runs into the hundreds, the job of reaming by hand is likely to become very monotonous and exceedingly tiresome.

For this reason the Bridgeport plant of the Singer Manufacturing Co. has devised means of applying power to the reamers without sacrificing the flexibility of the hand-reaming operation. All reaming of this kind is done in jigs, as may be seen by referring to the illustrations herewith, and all of the reamers are supplied with permanent handles, or "wrenches," which are in many cases the balance wheels of sewing machines, fitted and keyed to the shanks of the reamers.

Tables of cast iron, as may be seen in Figs. 1 and 2,

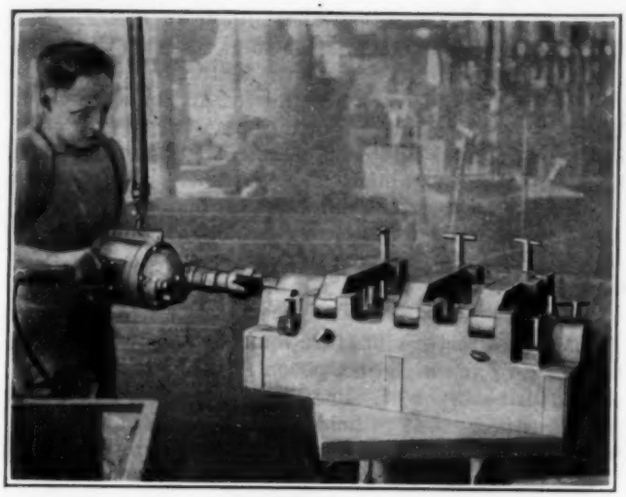


Fig. 1—Reaming with an electric drill

are provided to hold the reaming jigs at a height convenient to the operator. The surface of the table is planed smooth, as is the bottom of the jig, so that the latter may be swung about or turned end for end with ease, in order that the operator need not change his position constantly. A short tenon on the bottom of the jig, setting loosely into a hole in the table, prevents the jig from moving away from the operator or falling off on the floor when pressure is applied to start the reamers.

Two methods of applying power to turn the reamers are in common use: one employing an ordinary electric drill, Fig. 2, and the other making use of a special driving head to which power is transmitted through

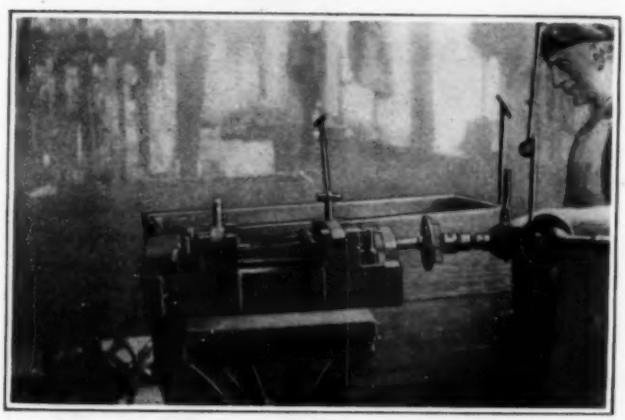


Fig. 2—The mechanically-operated driver

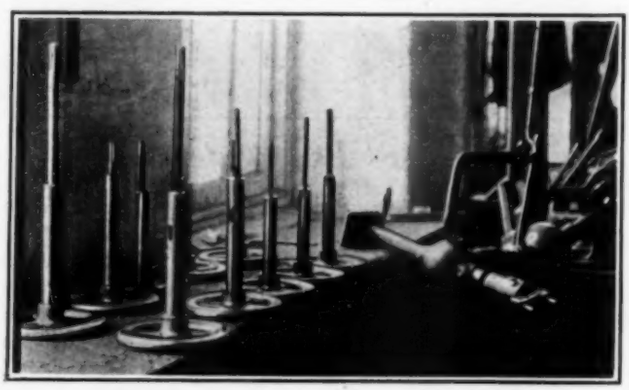


Fig. 3—A set of reamers for one job

miter gears and a universally jointed shaft, from a belt-driven countershaft conveniently located on the end of a nearby bench. Both tools are spring-suspended from the ceiling, so that the operator is not called upon to lift and hold a comparatively heavy weight during the operation.

In Fig. 3 may be seen a set of ten reamers, each with a balance-wheel "handle" applied to it, that are used upon one machine bed. In the same illustration may be seen the mechanical driving head as it appears when the operator lays it aside to unload and reload the jig.

A Lute for Babbitting Bearings

BY H. R. FOWLER

About twenty years ago, I saw a suggestion in *American Machinist* regarding the use of a mixture of asbestos and a high-flash cylinder oil in place of wet clay for stopping off bearings and similar jobs wherein babbitt was to be poured. It sounded good to us, we tried it out, and since then we have poured thousands of babbitt bearings, using this material as a lute.

There being practically no moisture present, as would be the case with a water mixture, there is no tendency for the babbitt to "blow" and burn somebody; besides which it insures a smooth and sound bearing.

The flash point of the oil should be from 600 to 800 deg. F., which is enough higher than the pouring temperature of the babbitt to prevent it from being burned away. The asbestos is also much cleaner than clay, and can be used repeatedly.

Pneumatic Stock Feed for Multi-Spindle Automatics

BY H. C. LINCOLN

The illustrations show a pneumatic stock feed for multi-spindle automatics that has been in constant use for two years. Fig. 1 shows the device attached to the machine and Fig. 2 is a sectional view of the mechanism. Where reference letters are used on both illustrations, the same letters indicate like parts.

To attach the device to the machine; first remove the pusher tubes and feed fingers, then insert the tubes *A* into the spindles, the tubes extending into the collets.

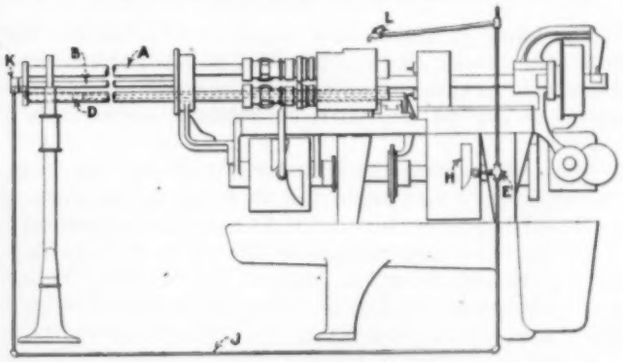


Fig. 1—Feeding device attached to machine

The device is held in position by the tie rod *B*, and is supported by a floor stand equipped with the usual rollers.

To operate the device, remove the four plugs *C* and insert a bar of stock in each tube, pushing the bars forward until the ends are flush with the outer ends of

the collets. Then tighten the collets, insert the aluminum pistons *D* behind the bars, screw in the plugs *C* and start the machine.

The automatic control valve *E*, operated by the cam *H*, admits air to the line *J* and to the distributing valve *K*. The air, passing through the distributing valve, forces forward the piston in one of the tubes, the piston in turn pushing forward the bar of stock against the stop, holding it there until the collet closes by the action of the machine. The first operation is then performed on that particular bar. At the completion of the operation, valve *E* is automatically closed by the cam *H*, and remains closed until the spindles have been

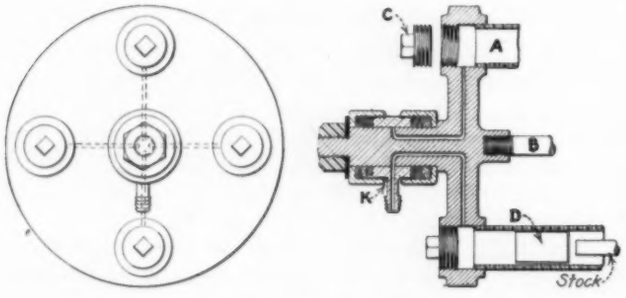


Fig. 2—Sectional view of feeding device

indexed to the next position, repeating the cycle at each indexing. The distributing valve *K* comes in line with the air port of the proper tube at each quarter turn of the spindle carrier.

When the stock has become too short for further work upon it, release the collets, remove the short pieces, remove the plugs, insert the air valve *L* in the front end of each spindle, in turn, and blow out the aluminum pistons. The device is then ready for reloading.

The advantage of this device over the ordinary feed fingers, is that it holds the stock against the stop and does not allow it to bound back before the collets are tightened. By this means the finished pieces are all kept to a uniform length.

Shrinking a Cylinder on a Brass Lining—Discussion

By John H. Uhreg

The guess in the answer to the question under the title given above, on page 172, Vol. 64, of the *American Machinist*, is almost sure to be a good one, but there is a way to get the desired result without taking such a chance.

When measuring the cylinder for fitting the liner, the cylinder should be in the shop where the liner is to be turned, so both will be of the same temperature. In taking the finishing cut on the liner, be sure it is allowed to cool from the heat of the roughing cut to room temperature. The liner should be turned to from 0.009 to 0.012 in. larger than the bore of the cylinder.

When preparing to put the liner in place, heat the cylinder to not less than 400 deg. F. A wood fire is all right, but the heating must be done slowly so as to allow penetration throughout the casting. All the tackle for handling should be in place before starting the fire.

Stand the bushing on end on a pair of parallels, preferably on a floor plate, and hold it by a bolt through the center and a clamp on the top, making sure that the clamp is shorter than the outside diameter. Run a stream of water on the inside so as to reach the whole surface—the colder the water the better.

After the cylinder has been heated and brushed clean, lower it over the liner, continuing to spray the inside until the cylinder has reached room temperature. The liner will then be tight.

A Rotary Milling Fixture

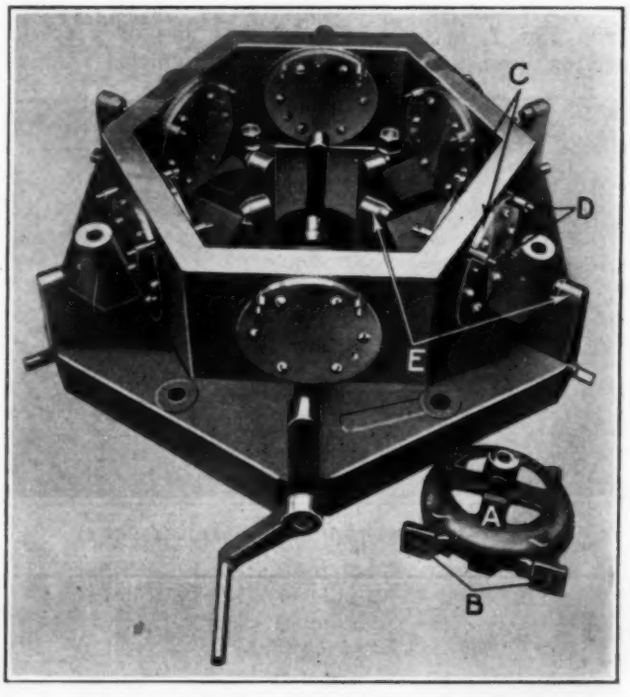
By W. F. Sandmann

The manufacture of fractional horsepower electric motors calls for high-production machine tools and special fixture equipment. The illustration shows a milling fixture that is used to hold the motor-end shields at *A* while the under-surface of the feet at *B* is being milled.

A vertical-type milling machine with a revolving table is used for the operation. The fixture is mounted on the table, where it is located by dowels and held down by six bolts. The hexagonal shape of the fixture provides the necessary flats for the locating plates *C*, of which two are mounted back to back at each station.

To load the fixture, the operator slips the end shields over the two locating dowels at *D* and tightens the clamps by means of the crank. The clamps are of the floating type in which the pressure is equalized between the two clamp fingers *E*, to pull the shields tightly against the locating plates.

Since the fixture revolves slowly, the operator has ample time to remove the finished pieces and reload each



Fixture to hold meter parts for milling

station, so that it is unnecessary to stop the machine except to change cutters.

When a different sized end shield is to be milled, it is but a few minutes' work to change fixtures. The company using this fixture has found it more economical to provide a different fixture for each size of shield, than to make a complicated adjustable fixture that would accommodate several sizes.

Characteristics of Ascoloy

Ascoloy is the trade name of a metal that is often called rustless iron. It has properties that resist atmospheric conditions indefinitely, is not affected by many of the chemicals that readily attack iron, steel, copper, and non-ferrous metals, and resists oxidation at temperatures up to 1,500 deg. F. It is manufactured by the owners of the process. The peculiar nature of Ascoloy is chiefly derived from the following elements that enter into its composition:

Carbon,	under 0.12 per cent
Manganese,	" 0.5 " "
Sulphur,	" 0.025 " "
Phosphorus,	" 0.025 " "
Chromium,	" 12 to 16 per cent
Silicon,	" 0.5 per cent
Nickel,	" 0.5 " "

Ascoloy is a ductile and malleable chromium-steel alloy, made in the electric furnace. It is handled in the various processes of fabrication in much the same manner as is used for ordinary steel, but with a little more difficulty. At present it is manufactured in the form of plates, sheets, billets and slabs, round; square, octagon and hexagon bars, forgings, wire, tubes, pipes, bolts and nuts, rivets, cold-rolled strips, and castings. The most important uses of Ascoloy are for pump shafts, pump rods, piston rods, screw-machine products, kitchen utensils, and parts that require a corrosion-resisting material.

Ascoloy is capable of being machined to the same extent as 0.3-carbon steel, and does not require special cutting tools or lubricant. It may be turned, faced, and threaded with facility. It may be drawn and formed to such shapes as are made from ordinary sheet metals.

Ascoloy may be soldered with soft solder by first cleaning the parts to be soldered with concentrated hydrochloric acid, and then thoroughly tinning the surfaces to be soldered. After this preparation, soldering is accomplished in the usual manner. Care must be taken to wash off thoroughly any acid remaining on the material. The use of soldering fluxes is not recommended. Brazing may be accomplished in the same manner as for ordinary steel, but it is essential to have clean surfaces.

Ascoloy may be welded by either the oxyacetylene or the electric-arc methods, but the acetylene method is preferred. To accomplish this method of welding the torch flame should be soft or neutral. The material welded to it should not be puddled, and the welding stick should not be removed from the flame during the welding operation. It is necessary to anneal the parts after welding, since Ascoloy is an air-hardening metal, becoming hard in cooling from high temperatures. Ascoloy may be spot welded on any of the commonly used types of electric spot-welding machines.

Ascoloy when ground and polished takes a permanent luster, and may be substituted for nickel-plated steel or brass, also for tinned copper and nickel-copper alloy. In polishing, a high-speed wheel should be used, and from 0.006 to 0.01 in. of material should be removed to insure a surface free from defects. When so polished, a luster is obtained that will remain permanent if cleaned periodically with a damp rag, or with any of the ordinary metal polishes.

Ascoloy may be annealed, tempered, or oil-quenched. Annealing at 1,500 deg. F. offers a Brinell hardness of 153. Tempering between 1,500 and 900 deg. F. will render a Brinell hardness ranging from 179 to 364. Oil quenching at 1,800 deg. F. will give a Brinell hardness of 364. If properly heat-treated Ascoloy will give a tensile strength as high as 200,000 lb. per sq.in. The typical physical properties of annealed Ascoloy are:

Ultimate tensile strength, 72,000 to 85,000 lb. per sq.in.
Elastic limit, 40,000 to 50,000 lb. per sq.in.
Elongation in 2 in., 32 to 37 per cent
Reduction of area, 70 to 78 per cent
Brinell number, 140 to 170
Thermal conductivity 67 per cent of that of wrought iron.

Ascoloy is more resistant to the action of salt water or brine solutions than either copper or steel. Immersed for 200 hours in an aërated 5 per cent salt solution showed a loss of only 0.037 per cent in weight, as compared with a loss of 0.850 per cent in copper, and a complete corrosion of steel. No loss in weight in Ascoloy was shown when immersed in 10 per cent solutions of boric acid, ammonium nitrate, ammonium carbonate, ammonium sulphate, sodium acetate, pyrogallic acid, citric acid, tartaric acid, or tannic acid.

When exposed to carbolic acid Ascoloy showed a loss only one-fifth that of the loss of steel under the same conditions. In a boiling 10 per cent solution of picric acid, only one-fortieth the loss in weight as compared with steel was shown. No appreciable loss in weight is shown in Ascoloy exposed to oil fatty acids.

Ascoloy, however, is dissolved completely in concentrations of hydrochloric acid, and is attacked readily by sulphuric acid, and by fused sodium nitrate. It is also readily attacked by molten zinc.

An example of one of the valuable uses of Ascoloy is for tools, pipes, and fittings in mines, especially in coal mines where highly impregnated waters are found. Under such conditions, where steel piping has been badly corroded or completely eaten away in a short period, Ascoloy has been known to resist completely the action of the waters for many months. Under the erosive action of high pressure steam Ascoloy has also proven to be extremely resistant.

For the data given we are indebted to the Allegheny Steel Co.

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

A Conveyor Belt Made of Wire

Q. We understand that there is a conveyor belt made of coiled wire that can be used for a number of various purposes and we are wondering whether this belt is suitable for annealing work.

A. There is such a belt manufactured from wire and so made that it can successfully be run over pulleys similar to those for belting conveyors.

The manufacturers claim that this wire belt can be used for annealing, spraying, filtering, screening, drying, moistening, cooling and steaming of parts while they are on the belt moving from one end of the conveyor to the other.

Machining Manganese Steel

Q. We have a number of manganese fillers for large sheave wheels that were not cored for a bolt as they should have been. Is there any practical way to drill these fillers, and are there any special drills made for working in manganese?

A. To our knowledge there are no tools made that can be used for drilling manganese.

There is a possibility, however, that you can put the hole through the parts by using an acetylene torch providing the fillers are not too thick, and we believe that rather than scrap them, this would be worth trying.

Bluing Steel Parts

Q. Please tell me how the operation of bluing steel is carried on. I refer particularly to the bluing of gun breeches.

A. The following method is used by the Springfield Armory for bluing parts of rifles, revolvers and other firearms and was previously printed on page 890, Vol. 60, of the *American Machinist.*

Immerse the chemically clean components in a mixture of 10 parts of nitre (salt peter) to 1 part of black oxide of manganese (MnO_2), by weight, heated to 800-850 deg. F. The mixture should be contained in a cast-iron pot, heated by any suitable fuel.

Best results are obtained when the components are contained in a wire basket. They are allowed to remain in the nitre for from 5 to 10 min., the longer the time the darker the blue.

Upon withdrawing the components, quench them in water at a temperature of from 125-150 deg. F. and, when dry, cover them with raw linseed oil and allow them to drain.

Springs are generally tempered from 450 to 600 deg. F., depending upon the analysis of the steel, the higher carbon content requiring the higher temperature, but even 600 deg. is too low for the nitre-bluing process and another method must be used. To get good results have the springs clean and then heat them on the surface of a layer of sand, contained in a pan, either in the furnace or by a fire applied underneath the pan, until the desired color has been obtained. The parts should be turned occasionally during the heating, and after the coloring is complete, they should be spread out to cool.

Machining Cylinder Cams

Q. We have a number of cylinder cams to cut from time to time. They run as large as 18 in. in diameter by 36 in. in length and contain one or more cam slots for the entire diameter. Each one is different from the others.

We do not want to buy a machine for doing the work but intend making some sort of a fixture to attach to a boring mill or engine lathe. We want to eliminate making a master for each cam, also.

Please let us have your suggestions.

A. We believe it would be of advantage to you to investigate the possibility of doing this work on a milling machine rather than on a lathe or on a boring mill. The reason for this is that it would be possible to follow the outline of the cam laid out on the cylinder with the standard controls on the machine as the cutter advances, a point that would be very hard to control without previously laid out forms in either a lathe or a boring mill, on account of the speed with which the work advances in the latter machine.

We believe it would be also to your advantage to consider making the cams of the plate variety, rather than cutting the slot into the cylinder, since by using the plate design the plates themselves could be handled very much more readily than could the heavy and large cylinder.

Tolerances in Drilled Holes

Q. We have had quite a discussion in our shop recently regarding limits or tolerances in a drilled hole. Please furnish us with the allowable tolerances in holes from ¼ to 2 in. in diameter that are drilled only. We desire these tolerances in diameter and in taper allowed per in. of hole depth.

A. Since it is possible by grinding a drill off center to make that drill cut many thousandths of an inch oversize, there are no set tolerances for drill holes short of grinding the drill on a special machine designed for the purpose. A great deal of care must be exercised to make the lips of the drill equal in every respect. When this work is done skillfully and care is exercised in the drilling, holes should result that do not vary more than five thousandths to fifteen thousandths oversize and it is possible to get much closer than this in the range of drills from ¼ to 2 in. in diameter.

The various manufacturers of drills and reamers have published considerable valuable material on the subject of drills and drilling and we believe it would be to your advantage to get in touch direct with them for their advice in your particular problem.

Technical Abstracts

Welding Cast Iron

The bronze welding method of repairing cast iron is adaptable for parts of intricate design, or where a machine cannot be dismantled, or in order to avoid a very slow, careful job of preheating. For instance, a very thin cast-iron shell, such as some type of water jackets, should be welded with as little heat as possible to prevent warping.

The mild heat required for properly applying bronze does not expand the base metals sufficiently to cause warping or cracking. Consequently extensive preheating is unnecessary and the weld can usually be made without the expense of dismantling and re-assembling.

When bronze welding cast iron a good grade of bronze rod and flux are recommended. Manganese bronze should not be used as it results in too hard a weld. — *Canadian Machinery and Manufacturing News*, March 18, p. 23.

Buying Up Germany

An interesting article, although bristling with learned economic terms, describes the process by which Germany is being bought up, and has to be bought up by foreign investors. The German balance of trade is now very seriously displaced in the direction of excessive imports. Before the war Germany had considerable investments abroad and the interest on these could be shipped to Germany in the form of commodities. Now Germany has no such investments. In consequence the only thing Germany can do is to borrow money abroad in order to pay for what she gets from abroad. And naturally in her strained condition she is forced to pay a heavy rate of interest. This accounts for foreign interest in her offerings. The loans may take the form of bond issues; or of stock issues. In the latter case foreigners actually become owners of German industry.

In England trust companies have been formed for no other purpose than dealing in Mid-European securities. The German Singer Co., which has been parading as a perfectly good German corporation, has been found to be owned entirely by the American Singer Co., so that all its earnings flow across the ocean.

Of great interest is the fact that Germany has stabilized her currency on the fixed basis of 4.20 marks to the dollar. In view of this there is no automatic adjustment of trade balance on the basis of rises and falls of rate of exchange. The writer sees no hope other than ultimate bankruptcy. The immediate bankruptcy has been avoided by foreign investments in Germany. But since this means nothing else than foreign creditors or foreign owners in Germany, the ultimate liquidation can hardly be avoided.—*Die Werkzeugmaschine*, Jan. 15, p. 6.

Malleable Castings

Malleable iron castings frequently are made brittle by hot-dip galvanizing. This characteristic can be cured by proper heat-treatment. To begin with, the castings must be clean and free from oxide and scale. They are then immersed in molten zinc at about 860 deg. Fahr. for a few minutes, removed and quickly cooled. Heating to between 1,100 and 1,380 deg. Fahr. gave good results and this brittleness was prevented. This treatment also served to reclaim any iron previously embrittled. This process has been tested on thousands of castings and has been proved successful. L. H. Marshall, in *The Iron Age*, Feb. 25, p. 558.

Machine Tool Design

Going back to 1900 and 1901, one finds that all important types of machines were in existence, and basically the tools of today closely resemble those of yesterday. Simplicity of outline and smooth round corners have replaced the square corners, and the modern unit reflects a more even balance of one part to another and one machine to another.

Some of the improvements in machine appearance must be attributed to casting development, square box-type lines being replaced by pleasing curves and well-rounded corners. Whereas once gray-iron castings were used throughout, now various types of castings are used in various places, dependent upon the requirements of strength. E. F. Ross in *Iron Trade Review*, March 25, p. 778.

Machine Tool Progress

With men as they are, the leader must not be too far ahead of his followers, or he will not be recognized as their leader but will be looked on as a lonely traveler. The good machine tool builder must never be at rest. He must be moving along in a certain path, a path of progress, and he must carry others with him. He must decide in advance upon the right path. He must foresee the way the world must move. The farther ahead he can see the more likely is his path to be the right one. He must move steadily along it, and must not wander from the track since by so doing his rate of progress is lessened and his strength wasted. —*The Machine-Tool Review* (England), Jan.-Feb., 1926, p. 1.

Nickel-Chromium Steels

The resistance to corrosion of ordinary rustless steels can be greatly improved by increasing the chromium content, but the use of higher chromium is not practicable, since it leads to the production of strongly air-hardening steels.

To produce a low carbon austenitic structure steel containing 20 per cent of chromium, a nickel content of at least 6 per cent is required. Similarly, a 15 per cent nickel steel requires about 5 per cent of chromium, though, unlike chromium, nickel alone in sufficient quantity will render a steel austenitic.

The general properties of these austenitic steels are their softness and that they may be stamped, pressed, rolled or drawn cold, but they harden rapidly under cold work. They are easily forged and rolled hot, and may be welded by any of the usual methods. In the soft condition they have a very high elongation and impact figure, but the limit of proportionality is low and the yield point is barely 50 per cent of the ultimate tensile strength. — *The Metallurgist* (England), Feb. 26, p. 25.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

Railroad Repair Shop Equipment

OPINIONS vary widely as to the amount of obsolete equipment in the railroad repair shops. Some critics place the figure very high, basing their estimate on the condition that existed just after the war and making no allowance for the recent change for the better. Others overestimate the extent of the improvement.

The actual situation at the present time is shown on a percentage basis in an article in this issue. Some encouragement can be gained from the very evident fact that the constantly repeated requests of the mechanical men for adequate equipment are finally gaining the ear of the management.

On the other hand the point has been made that the superintendents of motive power who contributed figures were those who had some new equipment to boast about while many of the ones who did not reply had no new equipment to report. In any case the situation of the railroad shops, with one third of their equipment less than ten years old, is not so bad as it might be although it could be a whole lot better to the very great financial advantage of the railroad managements.

The Metric Question Again

ARDENT advocates of the metric system insist that the changing from our present method can be made without difficulty; all that is necessary, they say, is to translate one into the other, and that we can continue building machines in their present sizes and using the same measuring instruments.

In these days of accurate workmanship and close tolerances this contention can hardly be borne out in general practice. When we begin to translate fractions with four to six decimal places into millimeters, it is hard to see how anything approaching accuracy or interchangeability can be maintained. The necessary dropping of decimals and the errors that creep into translations of this sort would seem to preclude the possibility of accuracy.

If the metric system has advantages enough to warrant its adoption, let it be done with our eyes open to the necessity of changing our dimensions, tools and measuring instruments.

Let us make up our minds that the change will cost a lot of money and cause confusion for a long time. Many of the so-called metric countries continue to use non-metric units in spite of the alleged advantages of the metric system—and the same situation would exist here.

With nothing to prevent its use when the people believe it to be of advantage to do so, there seems little excuse for the agitation that recurs intermittently, like ague, and which is again afflicting us.

Employers' Liability

ON ANOTHER page the case of a workman fatally injured while at work, for which the employer was judged not liable by a Virginia court, has been discussed in detail. While this case may clear up certain aspects of how far an employer is legally liable for accident, the decision can be open to much abuse that would be injurious to both employer and workman.

There is danger that if a certain type of employee becomes imbued with the idea that he remains responsible for injury in cases where he himself has made repairs faultily on tools, he will refuse to make repairs of any kind, the work naturally suffering thereby. The principle in the Virginia case might be applied to the mere sharpening of tools and improper setting afterwards. Once the principle becomes recognized, and labor organizations refuse to permit their members to endanger their liability by attending to equipment, serious production losses would result. Employers, therefore, can only temper the decision with plenty of common sense.

Growing Use of the Air Mail

THE reliability of the Air Mail has been thoroughly demonstrated during the past winter. During the two snowstorms that came in rapid succession, the important mail trains were running late. But the mail out of Chicago on one of those dates reached New York over two hours ahead of schedule.

For nearly a year the Trans-continental Air Mail, both in and out of New York, as well as the New York-Chicago Night Mail, has had a high percentage of "on time" arrivals. In spite of its being a pioneering development, the record compares very favorably with that of the old established train mails.

In spite of snow, fogs, rain and sleet, that sometimes bring death to the mail pilot, the Air Mail goes on with almost clocklike regularity. Non-delivery of air mail is a great rarity. The Air Mail is now a fixed item in the mailing schedule of many of New York's biggest users of both mid-western and transcontinental mail.

The volume of air mail is growing. It should be used by all business houses as a part of their mailing routine.

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"National Cleveland" Gear and Cutter-Tooth Grinder

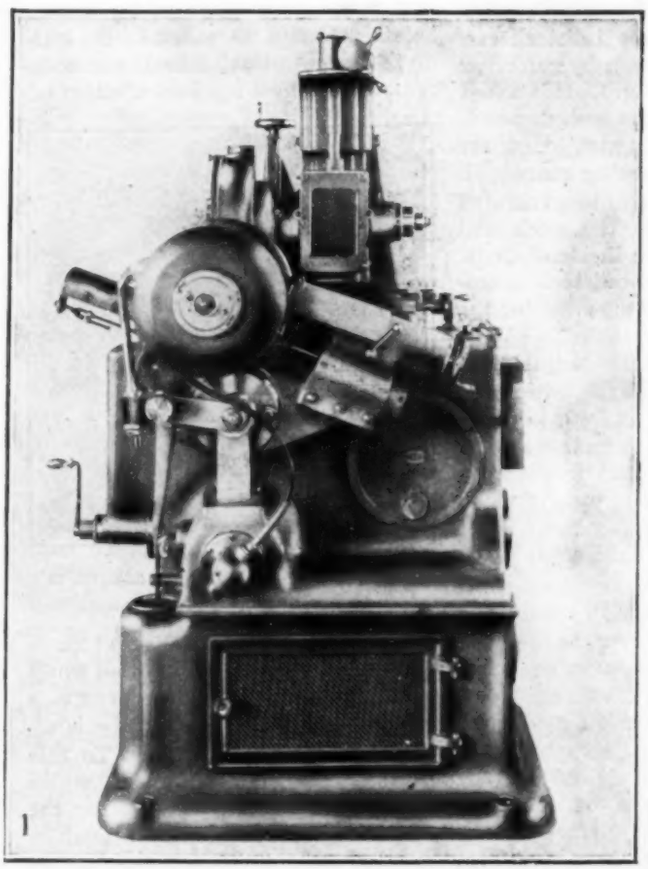
The National Tool Co., Cleveland, Ohio, has developed the gear and cutter-tooth grinding machine shown in Figs. 1 and 2 for grinding gears and gear shaper cutters by the Simmons method. Fig. 3 shows the working end of the machine.

The generating of the involute curve is accomplished by either of two methods, known as "molding generation" and "describing generation." In the first the curve is generated from the pitch circle and in the second it is generated from the base circle. Each method has its individual advantages but the "describing-generation" process is usually used for production grinding. Fig. 1 shows the machine as set for "molding generation" while in Fig. 2 is illustrated the "describing-generation" position.

The machine is driven by means of two ¾-hp. motors located in its base and ventilated through screen doors. One motor drives the wheel-spindle through a 3-in. cotton-web fabric belt. The belt is carried on flanged pulleys. This motor is mounted on an adjustable bracket on the floor of the bed of the machine. The other motor operates the remaining movements of the machine through a silent chain connected to the main drive shaft which runs longitudinally. The motor is hung from the top of the base. The crankhandle shown to the left in Fig. 1 can be used to operate this shaft by hand for setting the machine.

The main drive shaft carries a worm which drives a wheel 12 in. in diam., secured to a cross-shaft. On the end of the cross-shaft is a crankdisk which can be seen in Fig. 4. A rack-bar is connected to the crankdisk. This rack-bar operates a toothed sector secured to another cross-shaft. The same frame carries the bearings for both the sector and the rack. The frame is securely bolted to the side of the machine and the entire rack movement is inclosed. Two doors permit access to the mechanism.

On the opposite end of the same cross-shaft carrying the gear sector is secured a crank arm operating a connecting rod shown in Fig. 5. The connecting rod and bell crank actuat-



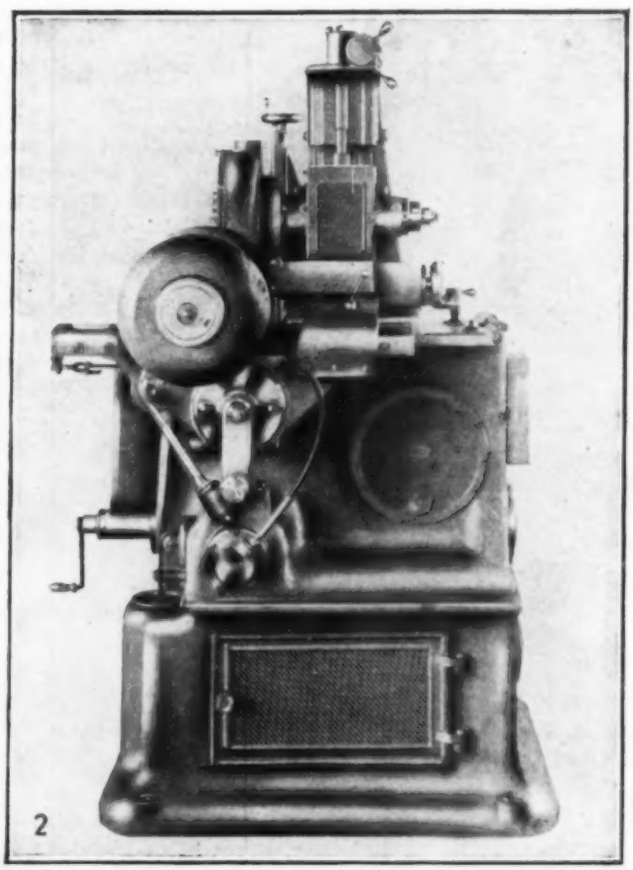


Fig. 1—"National-Cleveland" Gear and Cutter-Tooth Grinder, "Molding-Generation" Position. Fig. 2—"Describing-generation" position of the grinder

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ing the workspindle are illustrated as they are approaching the point where the indexing of the gear or cutter takes place. In Fig. 1 they are shown in a more advanced position in the cycle.

The construction of the workspindle can be seen in Figs. 5 and 6. It is composed of the spindle itself and a sleeve. The sleeve is carried on two large ball bearings one on each side of the cam which is shown in Fig. 6. The spindle has a plain bearing. It is ground and lapped to fit the hole in the sleeve. The spindle rotates from one tooth to the next as the gear is indexed and the sleeve having made a part of a revolution, returns to repeat the cycle.

The sleeve is operated by means of the connecting rod which is provided with a micrometer adjustment to advance or retreat the position of the sleeve. The cam mounted on the sleeve and rotated with it by the connecting rod, operates against a roller set in a stationary tailstock spindle. The workspindle unit is mounted on a sliding worktable so that the rotation of the cam against the roller forces back the worktable carrying the spindle. The table is returned by means of a counterweight carried in the base of the machine.

Fig. 4—View showing the crank movement

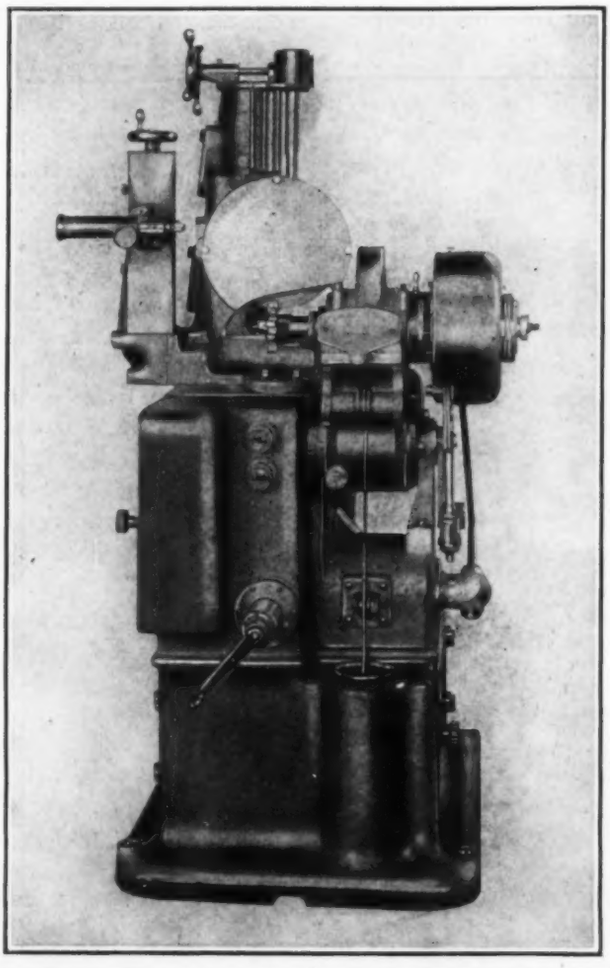

Fig. 3—Front or operating side of the machine

The construction of the tailstock can be seen by referring to Fig. 1. It is bolted to the swivel, previously mentioned, for obtaining gears with curves generated from the pitch and from the base circle. The tailstock straddles the slide for the worktable. A handle permits adjustment of the position of the tailstock spindle which can be clamped in place by means of the small lever on the side of the tailstock.

A flexible shaft shown in Figs. 1 and 6 drives the indexing mechanism for rotating the gear or cutter to the next tooth after the spindle has been moved back by means of the cam. The surface of the cam is a true involute curve about 6 in. in length so that in connection with the indexing mechanism, accurate generation of the teeth is secured. The accuracy of the cam is held to within plus or minus 0.0001 inches.

A Geneva indexing movement is operated by means of the flexible shaft. The construction of the mechanism, with the cover plate removed, is shown in Figs. 5 and 6. The acceleration of the movement is first advanced and then retarded between each tooth setting. A slotted anchor wheel is held in place by means of a pawl which drops into one of the slots at the completion of each indexing. The pawl is lifted out of the slot before indexing by means of a cam. Change gears permit the grinding of any number of teeth. These gears, which may be seen in both Figs. 5 and 6, transmit the power from the Geneva movement to a large gear on the spindle.

In order to feed the gear into the grinding wheel for the removal of stock a knurled wheel is provided. This small wheel can be seen at the left of the spindle in Fig. 6. In Fig. 5 the cover plate of the mechanism, which is threaded to the hub of the large anchor wheel, has been removed to show the arrangement of

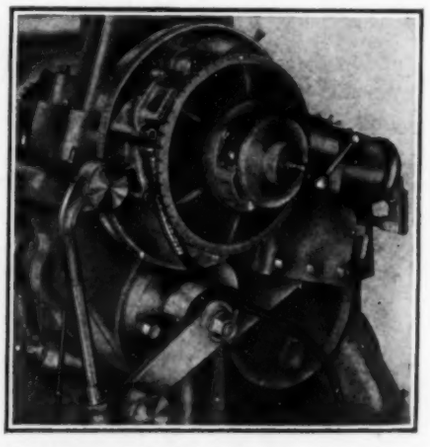

Fig. 5—The indexing mechanism

the spiral gears. The disk which is an integral part of the knurled wheel is toothed on its inner face to engage with a small spiral gear which is secured to a vertical shaft. To this shaft is secured a worm which transmits the movement to the spindle of the machine through a wormwheel.

The allowance of clearance on gear shaper cutters is also provided for.

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This is accomplished through the adjusting of the plane of the grinding-wheel face to the proper angle in relation to the cutter. A helical-grooved drum, shown in Fig. 4, is fastened to a shaft to the other end of which is secured a worm engaging the sector of a wormwheel. The grooves in the drum are graduated so that each division represents a movement of one minute of a degree in rotation either side of the normal. A gage indicates the position. The gage which follows the grooves in the

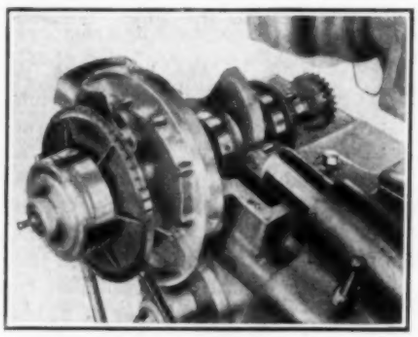


Fig. 6—The workspindle and the involute cam

drum slides on a pin secured in a bracket extending from the housing of the drum shaft.

Provision is also made for the truing of the grinding wheel. The diamond wheel-truing device can be seen mounted on a column to the left of the wheel in Fig. 3. A removable cover plate is provided on the wheel-guard for the entry of the diamond tool. The tool is moved toward or away from the wheel by means of a small knurled handwheel. The tool can be raised or lowered in its position by means of a handwheel at the top of the column.

The grinding wheel can be moved in or out from the diamond tool for truing by means of a small graduated handwheel which can be seen in Fig. 4. This can be done after loosening the two clamping thumb screws which may also be seen in this illustration. The grinding wheel can be raised or lowered by means of a handwheel at the top of the grinding-wheel column.

The machine will grind gears up to 10 in. in diam. and with a 1-in. face, by means of a plane-surfaced grinding wheel 12-in. in diam. With a wheel 18-in. in diam., the machine will grind gears with a 1½-in. face. It is intended for dry grinding. A 3-in. suction pipe is provided for removing the dust. The machine is completely wired and provided with a switch box to which is attached a condulet connection. Two snap switches for controlling the motors can be seen in Fig. 3 on the front of the machine.

Dust-proof oil cups are provided on the machine at points where lubrication is necessary. Ball bearings are used throughout with the exception of the grinding-wheel spindle and the work-carrying spindle proper. The grinding-wheel spindle is provided with two long bearings, one on each side of the pulley. They are lubricated by means of ring oilers that dip into oil wells having a large capacity.

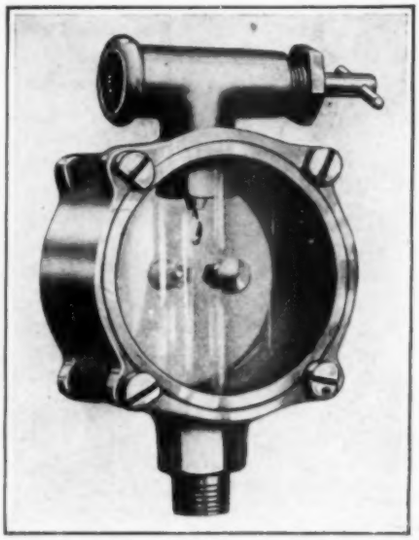
The gear and gear-shaper cutter checking machine for use in connection with the grinder was previously described on page 495, Vol. 64, of the *American Machinist*.

The grinding machine stands 5 ft. and 10 in. high and occupies a floor space of about 3x2 ft. Its weight is approximately 2,600 pounds.

Nugent Sight-Feed Valve

A sight feed valve, illustrated, for lubricating large engines and bearings is being manufactured by the Wm. W. Nugent Co., 410 North Hermitage Ave., Chicago, Illinois.

The device consists of a T-shaped valve provided with a hand control, pipe connection and a drip nipple, together with a glass inclosed compartment through which the oil drops fall and are observed. The two glass walls are 3 in. in diam. and have convenient handles in the center to facilitate removal for cleaning. The glass can be removed by turning the flat sides of the four holding screws inward and pulling on the handle. If the glass fogs one of the handles can be removed to permit the entrance of air. There is also a vent hole to prevent air binding when the handle screw is in place.

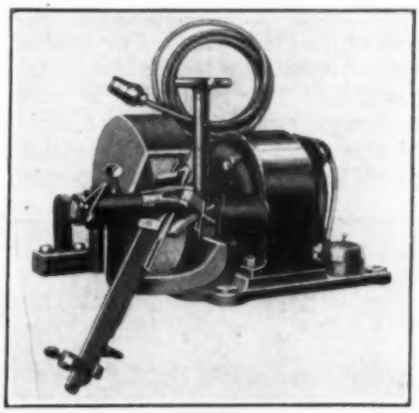


Nugent Sight-Feed Valve

The device may be set at any angle that is advantageous to the operator.

"Keypower" Tool Grinder

A portable electric grinder equipped with a special tool-holding fixture has been placed on the market by the Keystone Grinder and Manufacturing Co., Pittsburgh, Pa., under the trade name "Keypower." Although primarily designed to grind twist drills, the machine can be



"Keypower" Tool Grinder

adapted to grind any kind of edge tools, or can be used for general grinding purposes.

The work is ground on the face of the wheel, which is 7 in. in diam. and has a 1½-in. face, and which may be accurately dressed. A wedge-shaped fixture holds the tools rigidly and in proper relation to the wheel so that the results are uniform. A drill is accurately centered by means of this fixture and is ground with the required clearance. Regular equipment handles drills from ¼ to 1½ in. in diam. and an attachment for larger size drills can be furnished. In the Keystone light-pressure method of grinding air is used in-

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stead of water as the cooling medium, and it is claimed that no burning or temper drawing of the steel can occur.

The ¼-hp. Westinghouse motor is fully enclosed and ventilated, and is bolted to the base. An outboard bearing relieves the motor bearings of undue strain. The motor is actuated by a toggle switch mounted on the base. Rubber covered wire and a plug connection is furnished.

A hood guards the grinding wheel. The machine is portable and weighs 60 lb. The space occupied is 17x12x 10½ inches.

"Sickle" Universal Cutter and Reamer Grinder, Automatic

For the automatic rough and finish grinding of face, end, side and special milling cutters as well as gear cutters, taps and reamers, and for sharpening similar tools, the "Sickle" universal cutter and reamer grinder has been placed on the market in this country by L. Sichel, 6 Cliff Street, New York, N. Y. The machine is built in types 1 and 2, and in the accompanying illustrations the general construction of the type 2 grinder is shown.

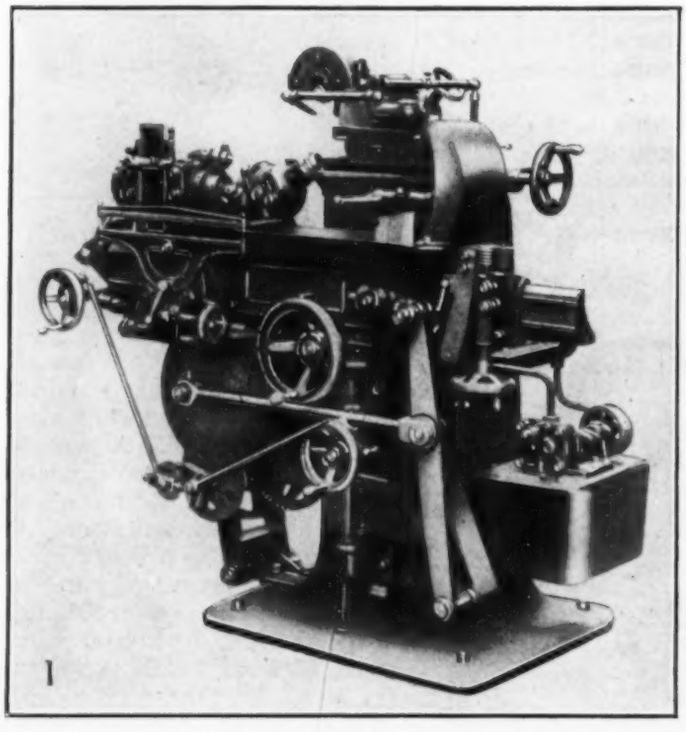
Tools having pointed or backed-off teeth, teeth spiraled up to 15 deg., and which are cylindrical or tapered up to 10 deg. can be handled on the machine. The operation is fully automatic, except for loading and unloading after the necessary adjustments have been made for the length, diameter, number of flutes, the taper and the angle of spiral. It is claimed that the machine can be used in place of a relieving lathe in cutter operations.

Either a belt or a motor drive can be used. Separate drives are used to the wheelhead and to the table movements. Fig. 1 shows a front view of the machine arranged for belt drive and Fig. 2 illustrates the arrangement at the rear of the machine, of the two motors for direct drive, each of 1 horsepower.

The column of the machine is of heavy construction with wide, flat ways for the vertical adjustment of the table. The adjustment is made by means of the handwheel shown in the center of Fig. 1. The handwheel rotates the vertical screw through bevel gears. Power vertical feed of the table is also provided for through another set of bevel gears operated by means of a crank and ratchet. The reciprocation of the table is secured by means of a large crank and vertical crankarm. These cranks are driven through gearing from the motor.

At the right of the worktable can be seen a micro-screw operated by means of a handwheel, for setting the table to provide for taper work. Near the center of the machine is a similar mechanism for setting the long sine bar to the angle desired for the helix.

The spindle of the headstock is designed to operate in connection with the sine bar for grinding spiral flutes. The device consists of a "chain brake" making several turns around the ball bearing sleeve in which the workspindle is fitted. Index plates are supplied for use on the spindle. The plates are notched to correspond with the number of flutes on the tool or with a multiple of the number of flutes. During the grinding operation there is no mechanical connection between the workspindle and gears in mesh so that the spindle is not subject to backlash. Center points can be ground on the machine to increase the accuracy of the work.



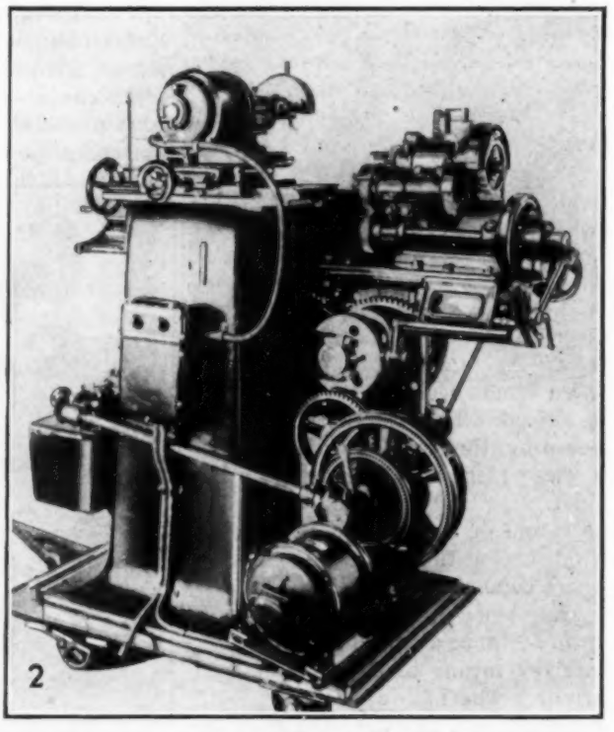


Fig. 1—"Sickle" Universal Cutter and Reamer Grinder, Automatic, Type 2. Fig. 2—A rear view of the machine

Shop Equipment News

The wheelhead has a compound adjustment so that it can be moved radially as well as for any angularity desired in helix grinding. The wheelspindle is compensating. By a combination of metals and by means of its design it is claimed that expansion from heating is counteracted so that the wheel is always in the same position relative to the work. The speed of the wheel is about 3,000 revolutions per minute.

An attachment is supplied with the machine for use in automatically sharpening the side teeth on both sides of cutters. This attachment is automatically indexed from the head. Its spindle can be swung 90 deg. in the vertical plane and 30 deg. either side of zero, at right angles to it as well as 30 deg. in the horizontal plane.

The machine is supplied with a pump tank and piping for wet grinding. The coolant system can be seen to the left of the column in Fig. 2. A fuse and switch box which can also be seen in Fig. 2 on the back of the column, is provided with two snap switches for starting and stopping the motor when direct motor drive is adopted.

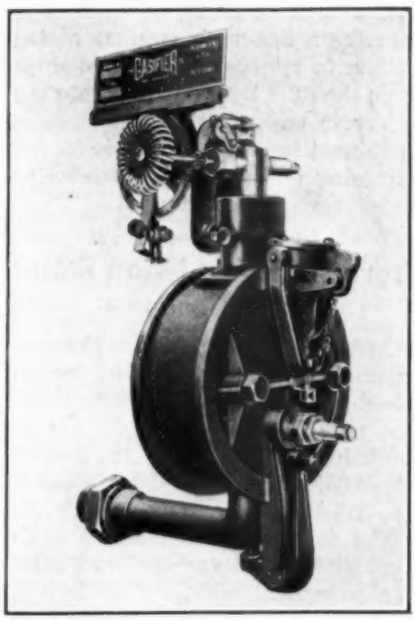
The type 1 machine which is not adapted to taper grinding will take cutters between the spindles up to 10 in. in length. The maximum table travel is about 6 in. while the maximum length that can be ground is 4 in. The maximum diameter that can be ground is 5¾ in. An 0.8-hp. motor is required. The net weight of the machine is about 1,200 pounds.

The type 2 machine will accommodate cutters on its centers, 16 in. in length. The maximum grinding length is 10 in., while the table travel is 12 in. The maximum diameter it will handle is 8 in. on centers and 10 in. on the swivel head. Cutters with up to 42 flutes can be ground. Helix angles up to 20 deg. are obtainable. The wheelhead can be swiveled 180 degrees.

The machine will accommodate hobs up to 2 d.p. and it will grind or sharpen reamers and taps having up to 42 straight or 36 spiral flutes. Two speeds are provided for the reciprocation of the table. These are 5 and 9 double strokes per min. or more according to the length of the stroke. The floor space required is 46x40 in. and the net weight of the machine is 2,400 pounds.

Socony "Gasifier"

The Socony "Gasifier" has been brought out by the Socony Burner Corporation, 26 Broadway, New York, for application to forges, ovens, and various types of industrial heating appliances. It is compact, and designed to save space. It has an adjustable flame, and one "Gasifier" can be used to operate several burners where the total capacity is sufficient for the heat required.



Socony "Gasifier"

The "Gasifier" is adjustable for the use of any grade of oil, from distillate fuel oil up to kerosene. The fuel is supplied by a small pump or by gravity, the pressure required being only 3 lb. It can be located within the most convenient reach of the workman, eliminating waste motion and saving labor. Once adjusted the operation of the "Gasifier" is constant and requires no further attention.

In the Socony "Gasifier" oil and air are introduced into a fixation chamber, the entry being controlled automatically by means of a proportioning valve operated by turning a single handle. The oil is atomized under low pressure, and injected into another chamber where almost flameless combustion is maintained. The high temperature of the gases in this chamber vaporizes the balance of the oil, and it is discharged from the "Gasifier" in the form of a mixture of fixed gas saturated with oil vapor.

After the primary ignition with a high tension spark the gasifying chamber sustains its combustion by the use of special alloy metal fingers in the path of the flame. Due to the critical temperatures and velocities maintained it is claimed that no carbon is deposited in the atomizing chamber when properly adjusted. The action of the "Gasifier" depends on the maintaining of a blue and almost flameless combustion in an excess of fuel vapor in the combustion chamber.

The "Gasifier" is manufactured in two units of capacity, F-1 and F-5. The size designated as F-1 weighs 15 lb., and measures about 8x2 in., and the F-5 size weighs 40 lb. and measures about 15x3 inches.

Hanna Rapid Riveter

A modification of the combination rivet and punch described on page 256, Vol. 62, of the *American Machinist*, has been announced by the Hanna Engineering Works, Chicago, Ill. The new machine, illustrated, permits inserting rivets from above and driving from below. This feature allows the press to be operated at 50 strokes per minute.

The mechanism consists of a combination of a simple lever and a toggle. The actuating force is supplied through a pneumatic cylinder and piston. The lever and link is so proportioned that there is a wide range of uniform pressure on the die

Hanna Rapid Riveter

Shop Equipment News

stroke. The die approaches the work rapidly and then decreases in speed as it enters the uniform pressure zone. Where the work is lightest, the speed is greatest, and, as the rivet head forms, the speed drops, the pressure increases to a maximum and is held there for several inches of piston travel. Ordinary variations in rivet length and plate thickness are automatically compensated without any screw adjustment on the die.

The riveter is made in sizes capable of driving ¼- to ½-in. rivets hot, and $\frac{5}{16}$- to $\frac{3}{8}$-in. rivets cold. It can also be used for punching.

Demco Safety Cleaning Machine

A machine for use in cleaning small parts and tools in connection with gasoline or any other inflammable cleansing fluid has been brought out by Demco, Inc., Baltimore, Md. It has been approved by the Underwriters Laboratories.

The device consists of a bowl in which the cleansing is performed, a reservoir for the fluid and a pump.

Demco Safety Cleaning Machine

The whole is mounted on a standard at a height that is convenient to the operator when standing. A self-closing cover is provided. It is accurately fitted to prevent the escape of inflammable vapor. A single lever lifts the cover and brings the pump into operation. The pump raises the fluid from the storage chamber in the base of the bowl and ejects it forcibly through a nozzle. The article to be cleaned is held in the operator's hand and the force of the stream is a function of the pressure applied at the handle of the pump. It is claimed that the cleansing fluid will enter all holes and corners and will thoroughly clean all parts of the article in its path.

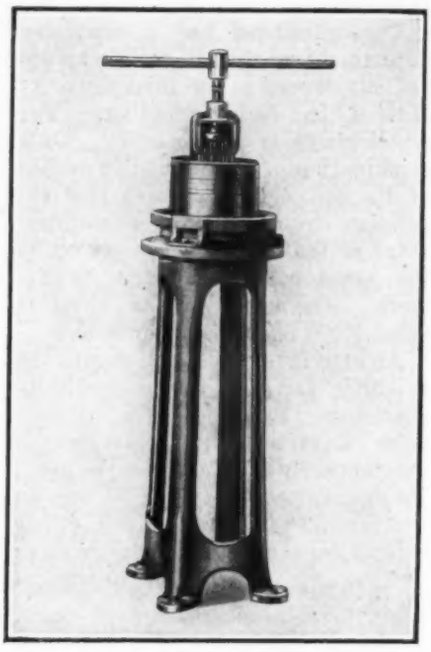
The bowl is 13 in. in diam. and contains a fine-mesh strainer at the bottom to remove the dirt and chips from the fluid before it falls into the reservoir underneath. The base is broad and is provided with holes for fastening down with lag screws so as to prevent upsetting it.

Stevens Transmission Stand for Fords

A fixture that facilitates the disassembly of the transmission, the flywheel-magneto, and the differential and ring gear of the Ford car or truck has been added to the line of "Speed-Up" tools made by Stevens & Co., 375 Broadway, New York, N. Y.

The function of the device is to securely hold the various Ford units in a convenient position so as to prevent the slipping and turning that would otherwise occur when the units are pulled apart. A simple frame that may be bolted to a bench or mounted on a column stand made of malleable iron holds several attachments, each designed to engage certain projections in the piece being operated on. For instance, the bolt heads on the flywheel assembly drop in grooves and it is then a simple matter to remove the six bolts in the driving plate, to pull off the clutch disk drum, and to drive out the transmission shaft. A second attachment holds the flywheel in the reverse position by means of holes engaging the projecting pins. The magnet cap screws may then be removed. Without any attachments the drums of the flywheel-transmission assembly can be slipped into the recessed head where they are held for replacement of the starting-gear.

The third attachment is used for operations on either side of the differential; the axle need not be removed. The attachment is reversible and has on one side a set of lugs



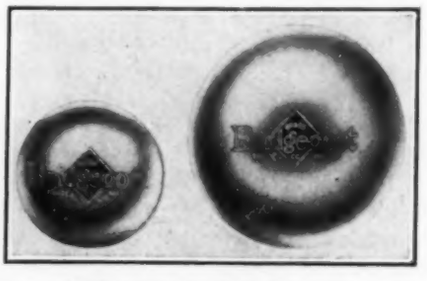
Stevens Transmission Stand for Fords

that catch the teeth of the ring gear, and on the other a set that mesh between the bolts holding the gear.

The complete floor model with the stand weighs 97 lb., whereas the bench model weighs 31 pounds.

Bridgeport Traffic Spots

Brass cups for marking divisional lines are being manufactured by the Bridgeport Brass Co., Bridgeport, Conn. They were originally designed for traffic purposes, such as for pedestrian lanes and traffic divisional lines, but they can be used as



Bridgeport Traffic Spots

well for marking lanes in industrial plants.

The spots as illustrated are made in two sizes, 3 and 4½ in. in diam. It is recommended that the 3-in. spots be spaced 12 in. center distance apart and that 16½ in. be the center distance of the 4½ in. spots.

News of the Week

Congress Recognizes Perpetual Motion Inventor

When only seventy of the 435 members of the House of Representatives were in attendance, Garabed's "illimitable, costless energy" bill was passed on April 5. The vote was 38 to 32. The bill as passed recognizes Garabed as the "first and original inventor" of the method of producing unlimited energy. It was the failure of Congress to include those words in a former resolution which caused Garabed to refuse to make a demonstration before government officials.

The first resolution precluded any sale or attempted sale of any interest in the invention pending the test before the officials, but no penalty was provided. The resolution just passed by the House supplied that omission by providing imprisonment for not less than three years for any such attempt.

Representative Davis, of Tennessee, formerly a member of the committee on patents pleaded with the House not to give a patent by special act to an individual which would establish "a very unusual and dangerous precedent." Garabed gave as his reason why he did not go to the Patent Office that he feared someone would steal his idea. The resolution declares he is the first and original inventor.

MacNider Organizes War Business Council

Under the provisions of the National Defense Act of 1920 the business activities of the War Department are now centered in great part in the office of the Assistant Secretary of War, the several supply branches of the Army, and the Finance Department. Col. Hanford MacNider, Assistant Secretary of War, proposed the creation of a War Department Business Council to be made up of outstanding leaders in those parts of the industrial and business world which are particularly allied with the current supply problems of the military establishment. Colonel MacNider's proposal was approved by Hon. Dwight F. Davis, Secretary of War, and the Business Council was appointed.

This expert civilian board has been asked to volunteer its service to study the present policies of Army puchasing and the administration of nation-wide Army procurement and to make constructive suggestions and criticisms which will assist the Assistant Secretary of War and the chiefs of branches in their present efforts to administer the Army on the most economical basis practicable.

At the first meeting of the War Department Business Council on March 13 the following civilian members were present:

Col. Leonard P. Ayres, vice-president, Cleveland Trust Co.; James D. Bonner, manager of sales, United State Steel Corporation; Brig. Gen. John J. Carty, vice-president, American Telephone and Telegraph Co.; Lieut. Col. F. S. Dickinson, president, Beeton, Dickinson & Co., surgical instrument manufacturers; George B. Dryden, president, Dryden Rubber Co.; Lieut. Col. Oscar W. Smith, president, Parke, Davis & Co.; Col. Wm. C. Spruance, vice-president, DuPont de Nemours Co.; Col. Wm. A. Starrett, vice-president, Starrett Bros.; Brig. Gen. Herbert S. Wolfe, consulting actuary, New York City.

The council was addressed by the Assistant Secretary of War, Col. Hanford MacNider, who outlined the mission of the council.

The meeting was also addressed by Col. E. D. Peck, in charge of current procurement, office of the Assistant Secretary, and by several chiefs of service, each of whom outlined the particular problem of his service.

Simonds Prize Essay on Simplified Practice

Recognition of the importance of simplified practice as a factor in the economic life of the nation is given in an announcement made last week by Alvan T. Simonds, of Fitchburg, Mass., that the fifth of a series of annual essay contests on economics for which Mr. Simonds is offering prizes of $1,500, would include, as the topic for 1926: "Saving and Spending as Factors in Prosperity—with Special Reference to the Effect of Simplified Practice and the Elimination of Waste on the Standards of Living."

Mr. Simonds is so convinced that a better knowledge of economic truth is so essential that for several years he has offered prizes for essays on economic subjects in order to induce people to learn more about the mechanics of the world they live in and about thrift that increases individual and general welfare. The contest is open to "everybody, everywhere," Mr. Simonds states, and will close Dec. 31, 1926.

"The essays are to be in two parts," the announcement states, "the first theoretical, dealing with the economic theory of saving and spending and setting up a thesis fitted to present conditions in the United States; the second, applied and illustrating by simplified practice and the elimination of waste the thesis developed in Part I. The parts must be so written that either part may be used as an independent unit."

The judges will be selected from experts in economics, business and related activities.

Cornell May Establish Sweet Memorial Professorship

As a memorial to John Edson Sweet, founder of the American Society of Mechanical Engineers, head of the college of engineering at Cornell University, and inventor of the straight-line engine, friends of Cornell University are raising a fund to endow a professorship at Cornell to be known as the "Sweet Memorial Professorship."

Professor Sweet died in 1916, and it was at that time suggested that a memorial might take the form of a new mechanical laboratory. Since then the plan has been modified. It was felt that a professorship is a more enduring institution, because stone and mortar may fall to decay, while a professorship becomes an imperishable part of the institution. More than half of the fund has already been subscribed by about one hundred men, and it is thought that other persons interested in engineering education will complete the fund within a short time.

Albert W. Smith, dean emeritus of Sibley college of mechanical engineering, and Dexter S. Kimball, present dean of the college of engineering at Cornell University, point out that Professor Sweet made a remarkable contribution to engineering education and that he is not only one of the outstanding figures in the history of engineering at Cornell but that his life and work have done much for the advancement of engineering interests throughout the United States.

Industrial Foremen to Study Their Jobs

The third annual convention of the National Association of Foremen will be held in Springfield, Ohio, on May 25. This will be a one day convention and all foremen from any industry are cordially invited to be present.

The program will consist of talks in the morning regarding the foremen's job as seen by industry as a whole, by management, by the workman, and by the foreman himself. Whiting Williams, of Cleveland, Cyrus McCormick, of the International Harvester Co., of Chicago, and Dr. Harry Myers, of Dayton, will be on the program. T. B. Fordham, works manager of the Delco-Light Co., is president of the association and will preside at this convention.

The delegates will visit several factories during the afternoon and will have an entertainment from 4:30 to 6:00 o'clock. At the banquet in the evening it is expected that C. F. Kettering, vice-president of the General Motors Corporation, will be the speaker.

Round Table Discussion of Practical Problems

A novel feature planned for the benefit of malleable foundrymen attending the second annual Foundrymen's Congress at Detroit the week of Sept. 27 will be the round table discussion of practical shop problems. The discussion will be informal, following a luncheon, and is being planned for the benefit of the practical shop man as well as the metallurgist and executive. Some of the subjects which have been advanced for discussion are:

"Advantages of old or new sand in making cores;"

"Method of disseminating scrap information to foremen and moulders;"

"Pattern standardization with view to determining most economical sizes for bench and squeezer jobs;"

"Methods of avoiding shrinkage in malleable castings and the extent to which it is commercially feasible to go in eliminating those faults;"

"Characteristics which affect unfavorably the machining qualities of malleable castings."

F. L. Wolf, technical director, the Ohio Brass Co., will preside as chairman of the round table meeting. The regular technical session on malleable iron will be featured with addresses by Enrique Touceda, consultant for the American Malleable Castings Association, H. A. Schwartz, research director, the National Malleable and Steel Castings Co., and D. M. Scott, works manager, the Symington Co., of Rochester.

Plan Survey of Old Machine Equipment

The legislative finance committee of Indiana will ask Governor Jackson to appoint a competent engineer or staff of engineers to make a survey of the machinery and power plant equipment of the various state institutions. The engineer or staff would be instructed to make a report back to the Governor as a guide in preparing the budget requests to be presented at the next legislature. It is said much antiquated machinery is being used in state institutions.

Oil and Gas Conference Next Week

In keeping with the action of Secretary of Commerce Hoover in encouraging industry to stimulate research, a large group of technical societies are participating in the Oil and Gas Power National Conference with a nation-wide program of meetings during the week of April 19.

The purpose of the conference is to focus the attention of physicists, chemists, engineers, operating men and industries on the recent progress and immediate possibilities in the utilization of oil and gas for power purposes. The program includes over seventy-five gatherings at industrial centers where the scientific, production and economic problems related to internal combustion engines and their fuels will be discussed.

Many new developments will be presented for public discussion and criticism, one of which will be the application of the high-speed Diesel engine for automotive traction service. The extensive application of the Diesel engine to locomotive practice which is now in process, the design of oil engines for stationary power plants and the increasing use of Diesel engines in marine work are some of the topics that will receive attention.

The public, as well as the entire engineering profession, are awaiting with great interest the reports on the series of tests being conducted by the Shipping Board on the huge Diesels ordered for Shipping Board Service. The test results will be reported during the conference.

Army Engineers Would Benefit by Federal Public Works Department

Expenditure of hundreds of millions of dollars each year on public works demands the creation of a scientifically organized Department of Public Works and Domain, it is asserted by Representative Adam M. Wyant, of Pennsylvania, in a statement made public by the American Engineering Council.

The structure of the Department of the Interior is outworn, and unless it is reshaped by Congress gross waste of public moneys will go on, declares Representative Wyant, who is leading the fight in the House to bring about the enactment of the Jones-Wyant bill, providing for the new department.

More than seventy organizations are allied with the American Engineering Council in the public works movement, which is being actively pushed by state and county committees of engineers all over the country.

Congressman Wyant's statement was given out by Dean Dexter S. Kimball of Cornell University, who recently succeeded former Governor James Hartness of Vermont as president of the American Engineering Council. Dean Kimball expressed the opinion that Congress will not pass the measure to create a reorganization board introduced some time ago.

A feature of the bill which is likely to be the source of lively controversy is the provision to transfer civil engineering work from the U. S. Corps of Engineers of the Department of Public Works and Domain. "The Army Engineers," Representative Wyant says, "should stick to soldiering."

"The experience of France, Italy and Germany, essentially military nations, proves conclusively that the 'military' argument for the retention of our civil works by our Army Engineers proceeds more from intrenched tradition and long-established custom than from the true interest of our national defense. Under the new arrangement the field of the Army engineer would actually be widened and the corps would not suffer.

"The training of the Army Engineers is essentially for military purposes. No school, however excellent, can in itself make an engineer in the full sense of the term. It can at best give but little more than the technical groundwork."

Varied Program for S.A.E. Meeting

Demonstrations by airplane pilots are planned as a special feature on one afternoon of the summer meeting of the Society of Automotive Engineers at French Lick Springs, Ind., from June 1 to 4. Another special advent will be a dinner for visiting and local members of the society that is being arranged by the Indiana section, to be held in Indianapolis.

Technical sessions will be held at the French Lick Springs meeting and there will also be an elaborate program of outdoor sports events.

Exhibits, demonstrations and hundreds of lantern slides will enable those who attend the sessions to visualize the principles and constructions explained by the speakers. At one of the sessions F. S. Duesenberg and Harry Miller are to explain some of the engineering features of their cars.

A number of new engineering developments will be announced and described in the addresses. Among these is a new type of rear axle drive gear that makes it possible to lower the height and center of gravity of the automobile and makes action of the gear silent. Another is headlighting with complementary colors, of which a demonstration is to be given.

Reports are to be made by representatives of several government bureaus of the latest results of investigations of anti-freeze solutions, road impacts of truck tires, engine wear due to crankcase oil contamination.

There are also to be addresses on research into the riding qualities of automobiles and the effect of seat cushions and cushion springs.

Metal Trades Re-elect W. D. Hamerstadt

Two nationally known executives Mrs. Marguerite B. Benson of Chicago, director of the women's bureau of the Illinois Manufacturers' Association, and Louis Ruthenburg, of East St. Louis, Ill., general manager of the Yellow Sleeve Valve Engine Works, were the speakers at the annual dinner and meeting of the Indianapolis branch, National Metal Trades Association, held in Indianapolis on March 31. The membership includes firms in Indianapolis, Connersville, Muncie, Richmond, Lafayette, Ft. Wayne, Evansville, Columbus and La Porte.

Results of a referendum vote for officers for next year show the following elected: W. D. Hamerstadt, of the Rookwood Manufacturing Co., Indianapolis, re-elected president; vice-president, U. G. Leedy, the Leedy Manufacturing Co., Indianapolis; treasurer, Lucius M. Wainwright, the Diamond Chain and Manufacturing Co., Indianapolis; executive committeemen for two years, Alfred W. Thompson, the Fairbanks-Morse Co.; O. B. Iles, the International Machine Tool Co.; James Hooker, the Sinker-Davis Co.; executive committeeman for one year, W. K. Swigert, the Stutz Motor Car Co. A. J. Allen is secretary of the organization.

Carnegie Tech Program of Metal Research

That another extensive program of mining and metallurgical research is planned at the Carnegie Institute of Technology in co-operation with the U. S. Bureau of Mines is indicated in the announcement that eight research fellowships will be available in connection with the program for next year. According to the announcement, the fellowships are open to graduates of colleges, universities, and technical schools who are properly qualified to undertake research investigations, and will be awarded for a ten months' period beginning Aug. 16, 1926.

Most of the research work will be conducted in the laboratories of the Pittsburgh Station of the U. S. Bureau of Mines, adjacent to the campus. The subjects for investigation, as in the past, will be selected by two advisory boards composed of metallurgists, mining engineers, chemists, and coal operators. At the end of the period of study, the results of the investigations, it is announced, will be published jointly by the Carnegie Institute of Technology, the Bureau of Mines, and the Advisory Boards.

Among the subjects suggested for study in the announcement are: Physical Chemistry of Steel Making; Production of Special Steels and Alloys; and Metallurgical Refractories.

Bureau Investigates Oil Viscosity

Some attention has been given by the Bureau of Standards to the relation between oil viscosity and the torque required to start an automobile engine in rotation, or to bring it up to a given speed. From the results thus far obtained it appears that while the viscosity of the oil does have a pronounced effect upon the power required to crank the engine at speeds of 100 r.p.m. and higher, it does not have any appreciable influence upon the torque required to start the engine rotating.

Interesting information on other lubrication problems has also been obtained as a by-product of the fuel research which has been in progress at the bureau for several years. Among other things it has been shown that excessive dilution of crankcase oil is one of the chief obstacles to the use of fuels of low volatility. An intensive study of this phenomenon has been made, and as a result considerable knowledge was gained both as to the probable mechanism of dilution and the measures which may be adopted to prevent or reduce trouble from this source. One phase of this study has been the development of suitable apparatus and methods for measuring dilution.

Chile Orders American Automatic Rifles

The government of Chile has awarded contract to the Colt Patent Fire Arms Manufacturing Co., of Hartford, Conn., for Colt-Browning automatic rifles for the use of the police.

Major Carlos Garfias, of Chile, military attache at Washington, plans to remain in this country until the contract is filled. The number of rifles to be supplied on the order, nor the price, have not been made public.

Major Garfias is said to be contemplating the purchase of Curtiss airplanes, and with other members of the Chilean mission will visit the Curtiss plant on Long Island.

Gear Manufacturers Complete Program for Convention

Announcement has just been made of the program for the annual meeting of the American Gear Manufacturers' Association which will be held at the Book-Cadillac Hotel, in Detroit, on May 13, 14 and 15. The list of speakers includes men prominent in the machinery and allied industries and the subjects cover all the important problems of the day.

The first part of the program is taken up with reports of officers and committees, the latter including standards and research work. The first address of the convention is on the afternoon of the opening day. Mason Britton, vice-president, McGraw-Hill Publishing Co., Inc., will discuss the question—"Are You Using Pre-War Stuff?" Following this address there will be two group sessions, one on general industry and the other on automotives.

At the evening session of the first day the speaker will be W. D. Price of the Warner Gear Co., whose subject is "Lifting the Veil of Oil Infections." Reports will be received from committees on spur gears, sprockets, keyways and nomenclature.

Addresses on the second day of the convention will be: "America, the Keeper of the Keys," by Charles E. Stuart, president of the Central Steel Co., preceded by general discussions on reports to be submitted by committees studying transmissions, non-metallic gearing, inspection, and cost accounting. At the annual banquet in the evening the toastmaster will be A. W. Copland and the principal speaker will be Charles F. Kettering, of the General Motors Corporation.

Two main addresses are included in the third day's program. Earle Buckingham, of the Massachusetts Institute of Technology, will talk on "Wear on Gear Teeth," and J. L. Williamson, of the Fellows Gear Shaper Co., will discuss "Predetermining Gear Tooth Quality."

Indiana S.A.E. Debates Axles

"The Battle of the Axles," was the title of a program at the April 8th meeting of the Indiana section of the Society of Automotive Engineers, held in Indianapolis. Papers and discussions on worm and kindred drives were given by Ray L. Buckendale, chief engineer of the Timken-Detroit Axle Co., of Detroit; C. H. Calkins, chief engineer of the Baush Machine Tool Co., of Springfield, Mass.; and George H. Acker, chief engineer of the Cleveland Worm and Gear Co., of Cleveland. The business meeting was preceded by a dinner.

National Academy Will Study Science

The ablest and most effective investigators in pure science in the United States will be selected by the National Academy of Sciences to conduct research in fundamental science, if a plan now under way to obtain immediate support for this pressing national need is successful.

An outline of the purposes of the undertaking, made public by a special board of trustees appointed by the academy, with Herbert Hoover as chairman, to secure immediate financial aid for pure science research, indicates that it is hoped to be able to make such provision that the most skilled scientific investigators will be able to work solely to the end that there will be an increase and strengthening of American contributions to the mathematical, physical and biological sciences.

A bulletin outlines the purposes of the fund, which has been given the indorsement of thirty university heads, and which would provide for close co-operation with universities and other institutions in the effort to increase interest in science for science's sake.

State Labor Department Lectures on Safety

In line with the nation-wide movement for accident prevention in industry, the New York state department of labor has made arrangements for a program of lectures on safety subjects to be delivered in the various continuation schools throughout the state.

Industrial Commissioner James A. Hamilton of the New York state department, and Morris E. Siegel, director of evening and continuation schools have combined their energies in a campaign of education of the teachers in the continuation schools in the principles and practice of "accident prevention," especially as it refers to "accident prevention" in industry.

Would Reduce Sizes of Ball Bearings

There is likely to be a reduction in the number of sizes of ball bearings of various types, especially those carried in stock for industrial application, as the result of a report made recently by a committee appointed at a conference of bearings manufacturers and users called by the division of simplified practice of the Department of Commerce.

The report elminates from 25 to 45 per cent of the S.A.E. standard sizes in different types. It retains, as preferred, 100 sizes of annular ball bearings in the light, medium, heavy and wide series; 47 sizes of the light, medium and heavy angular contact series; seven sizes of separable or open ball bearings, and four sizes of extra small ball bearings.

The next step to be taken by the division is to call a general conference to approve the publication and distribution of the reduced list to secure its general industrial acceptance.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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MY ENDEAVOR is to make these weekly reviews of real value to practical business men. To this end those who read them are invited to write to me, giving their views of the business outlook as well as any suggestions or criticism they may care to offer.

The aspect of business at present depends largely upon the spectacles through which it is observed. Those who are optimistic find confirmation for their views in large bank clearings, good railroad earnings, heavy car loadings and the relaxation of the money market. Those who are gloomy point to the decline in the stock market, the heavy losses that have been sustained there, the flattening out of the land booms and the lower prices reported for several commodities, including particularly silk, rubber, wool and pig iron.

The truth is probably between the two extremes. The subsidence of speculative enthusiasm has checked anticipatory buying, and the hand-to-mouth policy has again become general. This means a succession of small orders, to which production must accommodate itself. But it also means that there will be no boom, and that salesmanship and economy will be required to insure reasonable activity and profits.

The demoralization in the stock market seems to have passed, but this does not imply a resumption of the advance. Brokers' loans, as reported by the New York Stock Exchange as of the end of March, show a reduction of $535,000,000 for the month. They now amount to about $3,000,000,000 as against $3,535,000,000 at the end of February. But there is a feeling that even three billion dollars is a larger share of the country's bank credit than Wall Street should be using, and further liquidation appears to be indicated. No disorderly movement is, however, expected, and comparative quietude on the Stock Exchange seems probable at least until the volume and value of this year's crops can be approximated.

Meantime the investigation of the Tariff Commission and the implied demand for a reduction in some of our import duties is attracting the attention of the thoughtful as a factor that may cause some economic disturbance and become an important issue in many of the coming Congressional elections.

Against these cautionary admonitions it may be observed that the automobile production is at nearly record figures, and that the F. W. Dodge Co. announce that construction contracts let during the month of March were larger than for any previous month on record except August of last year. Perhaps this may explain why the steel industry is running at full capacity, although the price of pig iron has declined.

The outlook is in fact, extremely paradoxical, and the future is more than usually dependent upon the psychological attitude of the public. There can be no doubt that the country is opulent, but if consumers draw their purse strings and restrict their expenditures some contraction in business may be the result.

That this contingency is appreciated would seem to be indicated by the quiescence of the commodity markets. Grain is steadier, but the speculative buying that might advance prices is lacking. Cotton is remarkably stable, when the bearishness of the statistical position and the crop outlook is considered. Sugar has been decidedly more active. Early in the week it advanced on rumors that the Cuban Government would find some way to restrict production; later it declined on contradictory reports and then it recovered again on reduced crop estimates.

Coffee is lower. In some quarters the declining tendency is interpreted as indicating less rigidity in the Brazilian government's control of prices. Rubber is another imported article that is lower. The reason for the decline is not discernible, but tire manufacturers now claim to be pretty well supplied.

The dry goods market is slack. Cotton goods are if anything easier. So are woolen fabrics, and a decline of about 12 per cent in carpets was shown at an important auction sale held in New York last week.

But as an offset to the reactionary tendency discernible in many directions there is to be noted greater ease in the money market and a gain of 1.2 per cent in the Federal Reserve ratio, which now stands at 74.6 as against 73.4 per cent a week ago. This is due to an increase of 17 millions in the gold held and a reduction of about $45,000,000 in deposit liabilities.

The European situation was not seriously upset by the attempt on Mussolini's life, but it is admitted that the assassination of the Italian leader would have created something of a crisis in Italy. The French government appears to be making a serious effort to meet the financial situation, and French francs have improved slightly. Belgian exchange is also a little higher, upon the theory that a large loan will shortly be floated in this country. But the demonstrated weakness of the League of Nations has dulled the American appetite for foreign securities.

But to the great mass of Americans these transatlantic happenings are of but little interest, and when one reads that nearly $6,500,000 was deposited in the banks at Atlantic City, N. J., on the Monday and Tuesday that succeeded Easter he finds himself wondering whether anything can seriously disturb the prosperity or impair the consuming power of this great and wealthy nation.

What's Doing in Industry

A cursory examination of reports from important industrial centers gives the first impression that machine tool and machinery business has shown a decided tendency to slow up. Orders for large lots of tools are far and few between and inquiries, while plentiful, are slow in closing.

But taking into consideration all the many phases of merchandising in this particular trade, the business situation is normal and any slackening of new business is only a temporary breathing spell for readjustment of production activity.

New England business is prospering, conditions being better than in some time past. In the New York market sales are up to normal for this period, and there has been an increase in export business. In Buffalo sales are spotty but the outlook is bright. Philadelphia reports increased industrial activity with prospects for a brisk summer business.

The Mid-West continues quite active. Chicago reports room for improvement, but a better tone in the market, especially for used machinery. Orders in the Cincinnati district are scattered but the total presents a fair volume.

Increased inquiries in Milwaukee with requests for quick delivery give the market encouragement. Buyers in Cleveland are taking equipment at a conservative rate and prospects are good for continued business. In Detroit business is fair, orders being mostly for special machines for the automotive trade.

Recent developments in the business world indicate that there will be no boom, and that salesmanship and economy will be required to insure reasonable activity and profits.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

Business in this market has settled down to a normal pace. Orders are not plentiful, but practically every dealer and agent in this territory admits to a volume that is satisfactory.

It is a fact that inquiries are more numerous, even though most requests call for single machines of a special character. This type of business is providing the greatest profit for manufacturers at this time. Standard tools are in demand, but single pieces or small lots are the rule.

Export business has picked up in the past two weeks. Japan, Australia and the South American republics have come into the market, and indications are that this business will increase as the fine weather sets in. Mining and large industrial construction enterprises are the most important buyers of machinery and equipment.

Railroad buying has remained quiet, the New York Central being the only purchaser of note. Contractors' and road building machinery is fairly well represented in present sales.

Milwaukee

An improvement in inquiry is noted in the metal-working equipment trade, and the most satisfactory angle is that it indicates the possibilities of a broadening market, for the requests for prices, delivery dates and other information include prospective buyers who have manifested little or no interest of late. None of these inquiries are predicated on extensive requirements individually, but in the aggregate assume considerable bulk.

Manufacturers of equipment in this territory have been able to make considerable headway toward keeping deliveries even with specifications, while for some time past they have been behind on shipments as desired by buyers. Although this is due to a somewhat less active condition concerning new bookings in the past month or two, the ability to make prompt deliveries is actually responsible for some new business that might not otherwise come this way.

Automobile shops, in the main, are doing less in the way of acquiring new equipment than a year ago. They are now marking time. There has been no suggestion of deferred deliveries or cancellation of orders.

Despite a semblance of lessened activity, the trade looks forward to a steady demand that will at least maintain production on a satisfactory scale for several months to come.

Cincinnati

In view of the fact that the business trend has been upward for some time, Cincinnati machine tool manufacturers were somewhat disappointed to find that there was no increase in demand in the past week. Taking the trade as a whole, it seems to have held its own. It is not thought that there is more than a temporary lull, and for this reason manufacturers are not reducing their production.

Orders booked in the past week were well scattered over the different sections of the country and well diversified as to sizes and types. Concerns in the automotive industries were the largest buyers, but there was a slight dropping off in orders from this source.

The greater part of the week's business consisted of orders for single tools, for replacement purposes, going to users in various lines of manufacture.

Selling agents report a slight decrease in sales in the past week, but they regard the lull as merely temporary. Inquiries are coming in freely, they state, and the present hesitancy in buying will soon be overcome by actual necessity. The need for machine tools is known to exist, and in many cases it is urgent.

Buffalo

While there are some spotty aspects in the Buffalo machinery sales field, the majority of dealer opinion is that April is going to be a good month. Some dealers report the volume of business unabated and even those who report a slight slackening do not view it with pessimism. The belief is general that the future is going to be good.

The Buffalo Forge Co. reports that the first quarter of the year was considerably ahead of the first quarter of 1925. It is expected here that the second quarter will be even better. It is interesting to note in connection with the highly diversified aspects of the Buffalo Forge line that all are selling equally good. The activity is general and very satisfactory.

The movement of electrical equipment is good and is keeping pace with the trend of the general, machinery business.

Contractors' equipment is moving much better than last year at this time. While the season is late, it is interesting to note that the buying is much better and much earlier than in some former years.

Cleveland

"Quiet" is the term used by machine tool manufacturers and dealers to describe last week's business conditions. New orders showed a sharp decline in the first week of April. Single tools, from railroads, pipe works, structural shops and agricultural implement manufacturers, are the main orders booked in the local market.

Automotive inquiry and buying have dropped off suddenly. Curtailment of buying by this industry was necessary, it was stated, to avoid over production. With the tightening up of the market it is the opinion of the local trade that future buying will proceed in a conservative manner.

Some comment and discussions were occasioned by the recent receipt of a railroad order wherein a clause is included in which the buyer reserves the right to cancel in the event the order is not filled within thirty days.

Chicago

Dealers in machine tools, while stating that there is considerable room for improvement, are encouraged by the better tone the machinery market has shown during the last week. Those who specialize in used tools report the demand better than during the last weeks in March, with all indications pointing to a more active market by the end of April.

Inquiries are increasing in number and broadening in scope, but prospective buyers are slow to close. The Chicago representative of a large manufacturer of portable electric tools reports that the business done by his branch during March exceeded in volume that transacted in any one month for several years. Similar reports regarding the good demand for small tools come from other sources.

Used machinery inquiries, as for some time past, are chiefly for punch presses, millers, planers and shapers. Makers of milling machines, while still somewhat behind in deliveries, are approaching a normal condition on deliveries.

Philadelphia

Business in the machine tool and machinery industry in Philadelphia showed a slight falling off last week. This was not regarded in a serious light by dealers, many of whom asserted that there are indications of a brisk business that will keep most of the plants busy until early in July.

Some of the dealers said their business is from 50 to 60 per cent ahead of the volume for this period last year. This is especially true in small tool equipment, which has been moving more rapidly during the last six weeks than for almost a year. Orders which have been received by local dealers for milling cutters indicates a return to a business condition approaching the normal.

Dealers in boilers for small industries have experienced quite a brisk business. Power presses have been moving, and small dealers have received inquiries which indicate a busy summer.

Basic economical conditions in the industrial centers of Philadelphia appear to be satisfactory. The Palace of Machinery, Mines Metallurgy and Transportation for the Sesqui-Centennial, which is being built out of a $2,650,500 appropriation from the Government, got under way last week, and will be completed within sixty days.

Detroit

Little change has been noted in the machine tool and machinery market in Detroit and southeastern Michigan during the past week. Business is fair, with prospects that the pace will quicken before the end of April.

The larger automobile manufacturers seem to have their equipment in good shape, and large orders are not to be found with the freedom that marked this market six months ago.

Most of the machinery now being sold in automotive circles is special equipment. Milling machines, hobbing machines, multiple-spindle drills and lapping machines seem to be in demand.

Packard is buying some equipment for use in the manufacture of the aircraft engines ordered by the Navy department. Most of this is being placed in the experimental department. Some other machinery is being installed along the motor assembly line, all of it motor-driven.

Four tilting hearth-type furnaces have been installed in the new foundry at the Fordson (formerly the River Rouge) plant of the Ford Motor Co. The normal production from each of these is 200 tons of ingots a day.

The introduction of new models in the summer months is expected to mean the placing of several extensive orders for machinery this month.

Employment continues at a high peak, far ahead of the corresponding period last year, and industrial conditions in Michigan are generally good.

American Journalists Meet at Capital

Twenty-one North and South American republics were represented by foremost newspaper publishers, editors and reporters at the first Pan-American Congress of Journalists held at Washington last week. The delegates were welcomed to the meeting by President Coolidge and by Secretary of State Frank B. Kellogg.

Prominent speakers addressed the various daily sessions, and the topics stressed the promotion of mutual understanding, more efficient communication, less censorship of the press and a more sympathetic and intelligent grasp of the things that are truly within the province of the newspaper.

Dr. Walter Williams, dean of the School of Journalism, University of Missouri, was elected permanent chairman of the Congress. Willis J. Abbott, editor of the *Christian Science Monitor*, was elected vice-president to represent the United States.

During the week the delegates attended the laying of the cornerstone of the National Press Building, at which President Coolidge presided.

C. F. Barnes Dies

Carlyle Fuller Barnes, president of the Wallace Barnes Co. of Bristol, Conn., died at San Diego, Cal., on April 4. Mr. Barnes was known throughout the nation as a manufacturer of springs.

Mr. Barnes was born in Bristol in 1852, and received his education in the public schools and in Williston Seminary. The Wallace Barnes Co. was organized by his father. In 1893 he took over active management of the company on the death of his father. Under his direction the company has grown to be one of the largest manufacturers of springs and machine parts in the country.

Several years ago Mr. Barnes retired from active business and turned the control of the company over to his two sons.

Business Items

The F. A. Day Co., of Bristol, Conn., manufacturer of screw machines, will build a new plant on Riverside Ave. in that city.

The U. T. Hungerford Brass and Copper Co., of New York, has established a branch office and sales warehouse at 312 North Second St., St. Louis, Mo.

The Watson-Stillman Co. announces that after May first its main offices and sales department will be located at 75 West St., in New York.

The National Biscuit Co. has started the erection of a three-story power plant and machine shop in Evanston, Ill., to take care of the repair of the company's equipment in the Chicago territory.

The Grobet File Co., which recently notified the trade of a change in the address of its New York office to 3 Park Row, wishes to correct that address. The company is located at 3 Park Place .

The Rush Pump Co. has been incorporated at Indianapolis to manufacture gasoline and oil pumps. The incorporators are Leo E. Rush, Jacob H. Rush, Walter C. Holmes, Vadia M. Hall and Joseph H. Rush.

The Ohio Electric and Controller Co., of Cleveland, announces the appointment of the following sales representatives: The Railway Power and Engineering Corporation, of Toronto, Canada; and the Industrial Supply Co., of Birmingham, Ala.

The assets of the Pioneer Automobile Co., at Kokomo, Ind., have been ordered sold by the court. Included in the assets are all patterns, jigs and dies used in the manufacture of automobiles, all tools and special machinery.

The American Valve and Enameling Corporation has been incorporated at Indianapolis to manufacture plumbing and hardware specialties. The incorporators are Charles A. Wulf, Claude M. McElwaine and Frank Shellhouse.

The Anderson Tool and Die Co. has been incorporated at Anderson, Ind., to manufacture factory supplies, and materials. The incorporators are Charles I. Smith, Weir M. Miley, Isaiah Miley, Thomas M. Jones and Edward S. Ridley.

The Foote Bros. Gear and Machine Co., of Chicago, announces the re-election of W. C. Davis as president of the company. He is also treasurer. E. H. Vogt, former credit manager, has been elected secretary and assistant treasurer of the company.

The American Engineering and Sales Corporation announces the opening of general offices at 1317 F St., N. W. Washington, D. C. The officers of the company are: Walter N. Polakov, president; Wallace Clark, vice-president and secretary; I. B. Richman, treasurer. Mr. Polakov was formerly superintendent of motive power for the N. Y., N. H. & H. R.R. Co. Mr. Clark was at one time associated with the Lodge & Shipley Machine Tool Co.

Six executives of Dodge Brothers, Inc., have been promoted. Arthur E. Nafe, head of the service division, becomes manager of the national business sales division. Mr. Nafe is succeeded by Henry M. Wiegand, former chief inspector. F. R. Valpey has been appointed director of the commercial car and truck department, and R. W. Baskett supervisor of district offices and district personnel. C. J. Schwab has been made assistant to the vice-president and general sales manager and E. S. VanDalson has been appointed factory manager.

The Bell Tone Manufacturing Co., of Bridgeport, Conn., has purchased the factory building at No. 938 Crescent Ave., Bridgeport, owned by the Stanley Works of New Britain, Conn.

The Rollway Bearing Co., Inc., of Syracuse, N. Y., manufacturer of heavy-duty roller bearings, announces the following changes in the personnel of its sales force: C. A. Call, formerly assistant sales manager of the Gurney Ball Bearing Co., has been appointed sales manager. E. J. Lybert, formerly representing the Rollway Co. in the Philadelphia district, now takes charge of the Detroit district. J. D. Firmin, for many years associated with the engineering department of the Niles-Bement-Pond Co., is now engineering representative in the Philadelphia district. W. E. Smith has been transferred from the home office to the Youngstown district where he will assist Samuel Farrell, district representative. S. J. Kaiser continues to represent the company in the Chicago territory.

Obituaries

ELLIS C. LATHAM, vice-president of the Latham Machine Co., of New York, died at his home in Brooklyn on April 9. He was also president of the Latham Automatic Registering Co.

FRANCIS E. HOUSE, president of the Duluth & Iron Range R.R. died on April 4 at a hospital in Janesville, Wis., following a sudden illness which struck him while he was on his private car. Mr. House was born in Houseville, N. Y., in 1855. He became a mining engineer in 1880 and was chief engineer for many years of the Pittsburgh & Lake Erie R.R. He was elected president of the Duluth & Iron Range Railway in 1901 and retained that position until his death.

Personals

MAJOR GENERAL CLARENCE C. WILLIAMS has been reappointed Chief of Ordinance U. S. A.

O. T. LAWSON has been named factory manager of the F. B. Stearns Co., of Cleveland, Ohio.

JOSEPH BUTZ has been appointed sales engineer for the Indiana Piston Ring Co., with headquarters in Detroit.

H. A. PRATT has been appointed manager of the gas and oil engine departments of the Ingersoll-Rand Co.

HOWARD B. JERNEE has been appointed sales manager of the line shaft bearing department of the Hyatt Roller Bearing Co., of Newark, N. J.

FRANK H. DEWEY, assistant general manager, has been appointed general manager of the Wood Hydraulic Hoist and Body Co., of Detroit, manufacturers of power-operated hoists.

J. H. WELLER, formerly factory manager and vice-president of the Gray Motors Corporation, has been appointed general manager of the Acme Motor Truck Co., of Cadillac, Mich.

CHARLES S. WARD has been appointed sales manager of the Detroit Ball Bearing Co., of Detroit, Mich. He was formerly Detroit branch manager for the Timken Roller Bearing Service and Sales Co.

E. M. HUMMER, vice-president and general manager of the Defiance Machine Works, of Defiance, Ohio, sailed for Europe on April 14. He will visit England, France, Belgium, Germany and Holland in the interest of his company.

RALPH E. FLANDERS, of the Jones & Lamson Machine Co., has been selected to represent the American Society of Mechanical Engineers on the Anglo-American Conference Committee on International Screw Threads.

J. T. TRUMBLE, assistant chief engineer of the Olds Motor Works of Lansing, Mich., and formely connected with the engineering departments of the Buick, Chevrolet, and Sampson divisions of the General Motors Corporation, has been named chief engineer of the F. B. Stearns Co., of Cleveland, Ohio.

VERNE E. MINICH, president of the American Foundry Euipment Co., which has established a plant at Mishawaka, Ind., was the chief speaker recently at a meeting of the Mishawaka Chamber of Commerce, at which he and officials of the company were guests.

What the Railroads Are Doing

Authority has been granted to the Erie Railroad Co. to assume obligation for $2,900,000 of equipment trust certificates to be applied on the purchase of the following equipment: 1 Mikado-type locomotive, $69,000; 1 Pacific-type locomotive, $61,000; 100 steel suburban passenger coaches, $1,893,621.80; 24 all-steel passenger coaches, $724,005.84.

The New York Central R.R. has applied to the Interstate Commerce Commission for authority to assume obligation for $11,172,000 in equipment trust certificates to apply on the purchase of the following equipment: 2,000 gondola cars; 1,500 steel box cars; 960 automobile box cars; 1,000 hopper cars; 120 steel passenger cars; 39 combination baggage and mail cars; 20 dining cars; 18 baggage cars; and 20 milk cars.

The Baldwin Locomotive Works has received an order for 175 mountain-type locomotives from the Pennsylvania R.R. The Pennsylvania has also ordered 25 engines from the Lima Locomotive Works. The total value of Pennsylvania purchases is between $14,000,000 and $15,000,000, of which over $12,000,000 went to Baldwin.

Baldwin has also received an order for ten 3-cylinder engines from the Sorobana Railroad, of Brazil.

With receipt of the order for 175 locomotives from the Pennsylvania, the outlook for Baldwin Locomotive is the best since 1925.

News of the Automotive Industry

Reports to the Federal Reserve Bank in Chicago from automobile manufacturers producing 63.4 per cent of the total U. S. output in February, show that during that month retail sales by dealers were 73.2 per cent of their receipts from factories.

The motor situation has improved sharply during the last few weeks. Ford retail deliveries have shown improvement during the last two weeks, and production has been increased. The company reports sales averaging 600 a day greater for ten days ended March 20 than for preceding ten-day period.

Hudson shipped 31,500 cars in March, against 17,500 in March, 1925, and retail deliveries were 35,000 against 20,000.

Willys-Overland retail deliveries of Willys-Knight six and Overland six show an increase during the first quarter of 10,500 over last year. The new Willys-Knight 70 is just getting into production. Advance orders indicate a sales increase greater than any Knight model ever produced.

A second weekly record in the sales of Dodge Brothers automobiles and Graham Brothers trucks was made during the seven days ending March 27, when 8,583 cars and trucks were sold, according to the Dodge concern in Detroit. This record marks an increase of 23 per cent over the corresponding week last year.

Approximately 100,000 cars and trucks were sold in March by the 18,000 dealers of the General Motors Corporation, it was estimated. The estimated March sales may be compared to actual sales of 64,971 cars and trucks in February, 53,971 in January and 70,594 in March last year.

The Chrysler Motor Co. announces that retail deliveries last week exceeded the record set the week of April 18, 1925, and were 35 per cent above those of the corresponding week last year.

The largest single automobile shipment yet to be made in the history of the Canadian automotive industry recently passed through the Toronto terminals en route to Vancouver. The shipment was made on a special Canadian National train of 61 cars, carrying more than 290 automobiles.

The Republic Motor Truck Co. has brought out a new two-ton truck, known as Model 15, which replaces the former 11-X, and has standardized construction and design of its entire line of eight models, ranging in capacity from 1½ to 5 tons, in addition to two bus chassis.

At the direction of Edsel B. Ford, president of the Ford Motor Co., the name of the River Rouge plant of the company has been changed to the "Fordson Plant."

Trade Catalogs

Ball Bearings. The Norma-Hoffman Bearings Corporation, Stamford, Conn., has issued a booklet entitled "Precision Ball Bearings for Fractional Horsepower Motors." The booklet discusses the effect of the bearings on the life, efficiency and maintenance of motors.

Forging Machines. The National Machinery Co., Tiffin, Ohio. National Forging Machine Talk No. 55 is being distributed by this company. The folder describes the operations for forging an automobile door hinge.

Oil Tanks. Bowser, Fort Wayne, Ind. A circular has been published on gasoline and oil filling tanks especially for automobile service stations.

Small Tools. Gledhill Manufacturing Co., 107 Friendship St., Providence, R. I. Price list No. 5 on Gledhill combination center drills, center reamers and countersinks has been issued by this company. Tables of sizes, and illustrations are included.

Small Tools. The Kelly Reamer Co., Cleveland, Ohio, has issued a folder entitled "A Tool Service," covering Kelly M Cutters and special production tools. Brief descriptions of each type are given.

Small Tools. McCroskey Tool Corporation, Meadville, Pa. An illustrated circular has been published on the McCroskey adjustable reamers, chucks and collets, and turret. The features of each tool are described.

Tramrail Systems. The Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, has published an eight-page circular showing installations of tramrail conveying systems in various organizations. Paragraph descriptions are used in connection with each photograph.

Turret Lathes. The International Machine Co., Indianapolis, Ind. A loose-leaf catalog has been issued by this company, covering the "Libby-International" turret lathes. Several types are illustrated and described in detail. Photographs are used profusely to show the various units of the machines.

The descriptions are thorough and well-organized.

Wrenches. J. H. Williams & Co., Buffalo, N. Y., have published booklet No. A-81 covering their line of carbon-steel wrenches and chrome molybdenum "superrenches." The booklet contains fifty-six, 3½x6-in. pages, well-illustrated and listing full specifications of the various sizes and types.

Calendar of Local Meetings

National Association of Cost Accountants

Milwaukee. April 16. Brass Foundry Costs.

Mohawk Valley. April 19. Plant inspection visit to Rome, N. Y.

Twin Cities. April 20. A Cost System for a Small Manufacturer.

Hartford. April 20. Dinner meeting. Address by Durward Earle Burchell of Harvard University.

Los Angeles. April 20. Costs as a Factor in Management, E. R. Maule.

Pittsburgh. April 21. The Costs of Cost System Installation and Operation.

Rochester. April 21. The Application of Incentive Wage Plans.

Syracuse. April 21. Practical Psychology in Business.

Cleveland. April 21. Use of Mechanical Appliances.

Boston. April 22. Standard Costs and Variations, A. R. Davis.

Buffalo. April 22. Profit and Loss Statements.

Detroit. April 22. Material Costs Control.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

Society of Automotive Engineers

Cleveland. April 19. Subject not announced.

Chicago. April 23. "Motorized Rail Car Development," by A. W. Scarratt.

American Society of Mechanical Engineers

Chicago. April 19. Joint meeting with Western Society of Engineers. Speaker: W. B. White, consulting engineer for the piano industry.

Buffalo. April 20. Hotel Statler. "Modern Diesel Engine Practice," by J. T. Clancy.

Houston. April 20. Annual dinner, University Club. Indianapolis. April 20. Joint meeting with the A.I.E.E. "Development of Steam Generators and Radiant Heat," by George A. Orrock.

Nebraska. April 21. Grand Hotel, Lincoln, Neb. "National Defense and Industrial Mobilization," by Dean P. F. Walker, the University of Kansas.

Toledo. April 22. Oil and Gas Power Week.

Atlanta. April 22. Joint meeting of the A.S.C.E., A.I.E.E., A.C.S. and A.S.M.E.

Cincinnati. April 23. "Training Apprentices," by P. C. Molter, National Metal Trades Association.

Colorado. April 23. Metropole Hotel, Denver. Dinner meeting.

Philadelphia. April 23. Engineers Club. "Oil and Gas Power."

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Forthcoming Meetings

National Metal Trades Association. Twenty-eighth annual convention, Hotel Astor, New York, April 15 and 16. Secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

American Welding Society. Annual meeting, Engineering Societies Bldg., New York City, April 21, 22 and 23.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 29th St., New York City.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

STEEL and copper hold firmly to the Apr. 2 price levels. Slight easing off is reported in tin, lead, zinc, fabricated brass and copper (except copper wire) and scrap brass. Minimum quotation on blue-annealed steel sheets is up 5c. and that of galvanized, 10c. per 100 lb. at Pittsburgh mills, comparing present prices with those of a week ago. Pig iron remains firm in Eastern producing centers, while declines are reported in the West. March production of 4,491,689 tons of steel ingots, for the entire country, is the heaviest monthly output on record. This may have a weakening effect upon the price structure unless the present increasing demand gains more momentum. Principal hot-rolled products are unchanged from last week's levels at mills, namely, bars, $2@$2.10, shapes, $1.90@$2 and plates, $1.90 per 100 lb. f.o.b. Pittsburgh.

(All prices as of April 9)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.50	3.89	3.25	3.50
No. 12	2.55	3.94	3.30	3.55
No. 14	2.60	3.99	3.35	3.60
No. 16	2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.60	4.65	4.25	4.25
Nos. 12 to 14	3.70	4.75	4.35	4.35
No. 16	3.85	4.90	4.50	4.50
Nos. 18 to 20	4.00	5.05	4.65	4.65
Nos. 22 to 24	4.15	5.20	4.85	4.80
Nos. 26 and 27	4.30	5.35	5.10	4.95
No. 28	4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — B.W.G. and Decimal Fractions		Outside Diameter in Inches — ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00†
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.60	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. *Flat, 3/16@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.25
Tin, 5-ton lots, New York			65.00
Lead (up to carlots) E. St. Louis	7.90	New York	9.00
Zinc (up to carlots) E. St. Louis	7.00	New York	8.00

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	19.50	24.00	26.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.50	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.12½	42.00	38½@42½
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			81.62½
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.00
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00	Electrolytic 38.00	Shot	32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.00@12.25	11.25	11.25@11.75
Copper, heavy, and wire	11.25@11.75	11.50	10.75@11.25
Copper, light, and bottoms	9.50@10.00	10.00	9.75@10.25
Heavy lead	7.12½@7.62½	7.50	6.75@7.25
Tea lead	5.00@5.25	5.00	5.50@6.00
Brass, heavy, yellow	7.25@7.50	7.25	7.50@8.00
Brass, heavy, red	9.50@9.75	9.50	8.75@9.25
Brass, light	6.00@6.25	6.00	7.00@7.50
No. 1 yellow rod turnings	8.25@8.50	8.00	7.75@8.25
Zinc	4.50@5.00	4.75	4.25@4.75

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.20
Cotton waste, colored, per lb.	.10@.14	.17	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.15	2.25	2.75*
Roll sulphur, per 100 lb.	3.60†	3.35	
Linseed oil, per gal., 5 bbl. lots	.83¼	.96	.85
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb.	.1662½	.1687½	.1612½
Solder (½ and ½)	per lb.	.4012½	.4025	.36
Cotton waste	per lb.	.13@.17½	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	33
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.00@3.25
Coke, prompt foundry, Connellsville	per net ton		4.50@5.00
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Mass., Boston—Schoolhouse Dept., F. E. Slattery, Ch., City Hall—metal working machinery for Donald McKay School, Cottage St., East Boston.

Mass., Malden (Boston P. O.) — Malden Machine Tool Co., 158 Exchange St.—6, 8 and 10 in. heavy lathes.

Mich., Grand Rapids—American Seating Co.—machinery for proposed 100 x 258 ft. pressed steel shops and 45 x 59 ft. foundry, etc.

Minn., Minneapolis—Jordan Machine Tool Co., 1854 East 28th St., L. E. Jordan, Pres.—engine and turret lathes and other equipment for proposed 1 story, 70 x 110 ft. addition to factory.

Mo., St. Louis—City, E. E. Wall, Dir., 7700 Gravois Ave.—36 in. shear to cut 14 gauge sheets, 36 in. wide and $\frac{1}{4}$ plates 9 in. wide also 36 in. brake for bending above plates and forming roll for forming $\frac{1}{4}$ x 3 in. strips 8 in. in diameter.

N. Y., Buffalo — Bd. of Education, 900 Genesee Bldg.—will receive bids April 15 for manual training and machinery equipment for various elementary schools.

O., Franklin—Philip Carey Roofing Co., M. David, Mgr.—complete metal working equipment for recently acquired factory.

O., Toledo—S. F. Karm Co., 1685 Dorr St., S. F. Karm, Mgr.—complete equipment for stamping plant.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., Chamber of Commerce Bldg., Pittsburgh — equipment including lathes, milling machines, grinders, radial drills, presses, etc.

Tex., Port Arthur — Standard Brass & Mfg. Co., c/o H. J. LeBlanc—moulding machines, shears, grinders, magnetic separators, etc. for brass and polishing plant.

Wis., Green Bay—Brown County Motors, Inc., 610 Main St.—lathe, drill press, air compressor, etc. for proposed 77 x 170 ft. garage and service station. Estimated cost $100,000.

Wis., Milwaukee — M. J. Skubal, 149 Clinton St.—welding equipment for proposed plant, South Pierce St.

Opportunities for Future Business

Ala., Birmingham — Connors Steel Co., Empire Bldg., plans the construction of plant addition, here, for manufacture of reinforced concrete bars, rail carbon, etc.

Ala., Birmingham—The Continental Gin Co., Title Guarantee Bldg., manufacturers of cotton gin machinery, awarded contract for the construction of 6 factory buildings, all 1 story. Estimated cost $300,000.

Conn., Bristol—F. A. Day Co., Riverside Ave., manufacturers of screw machine products, awarded contract for the construction of a 1 story, 25 x 75 ft. factory.

D. C., Wash.—Capitol Garage Co., 1416 H St., N. W. had plans prepared for the construction of a 10 story, 156 x 200 ft. garage. Estimated cost $1,000,000. A. B. Heaton, 1211 Connecticut Ave., N. W., Archt. Noted Dec. 31.

Ga., Rome—Standard Stove & Range Co., E. P. Grant, Mgr., soon awards contract for the construction of 100 x 350 ft., foundry. Estimated cost $40,000. Noted Mar. 4.

Ill., Murphysboro — Standard Oil Co. of Indiana, W. J. Lang, Dist. Mgr., 2320 Division St., Evansville, Ind., having preliminary plans prepared for the construction of a 2 story, service station, including garage, 19th, Mobile and Ohio R.R. tracks, here. Estimated cost $100,000. Private plans.

Ill., Rockford — J. W. Miller Incubator Co., 2500 Latham St., plans the construction of a 2 story, 150 x 250 ft. factory and warehouse to replace fire loss. Estimated cost $150,000. Architect and engineer not selected.

Ia., Davenport—Blackhawk Foundry & Machine Co., awarded contract for the construction of a 1 story, 70 x 90 ft. foundry.

Mass., Boston—Motor Mart Garage, 27 School St., awarded contract for the construction of a 6 story garage and stores building at Columbus Ave., Stuart and Elliot Sts. Estimated cost $2,000,000.

Mass., Boston—Savoy Realty Co., c/o M. Linenthal, 333 Washington St., Engr. awarded contract for the construction of 2 story, 160,000 sq.ft. repair and service garage, Washington and Perry Sts. Noted Apr. 8.

Mass., Lexington—J. C. Phelps, 43 Percy St., awarded contract for the construction of 60 x 100 ft. repair and service garage, 33 Bedford St. Estimated cost $80,000. Noted Apr. 8.

Mass., Pigeon Cove (Rockport P. O.) — Cape Ann Tool Co., will build a 65 x 155 ft., forge shop and boiler house extension, at plant, here. Estimated cost $40,000.

Mass., Reading—Municipal Street Dept., is having preliminary plans prepared for the construction of a 1 story garage and repair shop. Estimated cost $50,000. G. H. Sidebottom, 101 Tremont St., Boston, Archt.

Mass., Walpole—Bird & Son is receiving bids for the construction of a 3 story, 70 x 260 ft. maintenance and storage building. Monks & Johnson, 99 Chauncy St., Boston, Archts.

Mass., Westfield — Foster Machine Co., South Broad St., awarded contract for the construction of a 3 story, 80 x 235 ft. addition to factory. Estimated cost $200,000. Noted Apr. 1.

Mass., Worcester—Mack Motor Truck Co., 75 North Beacon St., Boston, awarded contract for the construction of a garage and repair shop on Shrewsbury St. here. Estimated cost $125,000. Noted Feb. 25.

Minn., Hopkins—Minneapolis Threshing Machine Co., Hopkins St., Minneapolis, awarded contract for the construction of a 2 story, 60 x 100 ft. factory, here. Estimated cost $100,000.

Mo., St. Louis—Century Electric Co., 1827 Pine St., awarded contract for the construction of a 2 story, 240 x 400 ft. electric manufacturing plant at 3739 Market St. Estimated cost $250,000.

Mo., St. Louis — Famous-Barr Co., Seventh and Locust Sts. awarded contract for the construction of a 3 story, 107 x 230 ft. garage at 622 Walnut St. Estimated cost $150,000.

Mo., St. Louis—Koken Co., 2528 Texas Ave., awarded contract for the construction of a group of buildings, 1 story, 160 x 220 ft., 2 story, 100 x 160 ft., 1 story 100 x 160 ft. and 1 story, 80 x 160 ft. for barber supply factories on Morganford St. Estimated cost $150,000.

N. J., Camden — Mack International Motor Truck Corp., 741 Market St., awarded contract for the construction of a 1 story, 190 x 252 ft. service station at Sixth and Jefferson Sts.

N. Y., Rochester—Broad Building Corp., c/o R. J. Reidpath, Mutual Life Bldg., Buffalo, Engr., will soon receive bids for the construction of a 6 and 10 story garage and office at Broad and Exchange Sts. Estimated cost to exceed $500,000.

N. C., Winston-Salem—W. N. Reynolds & R. E. Lassiter, will soon receive bids for the construction of a 4 story, 160 x 200 ft. garage on North Main St. Estimated cost $300,000.

O., Canton—Everhard Mfg. Co., 317-319 Schroyer Ave. S. W., manufacturers of metal specialties, will receive bids until May 1 for the construction of a 1 story addition to factory on 7th St., S. W. Estimated cost $40,000 to $50,000.

O., London—London Buick Co. is having plans prepared for the construction of a 1 story, 40 x 90 ft. garage at High and Walnut Sts. Estimated cost $60,000. Private plans.

Pa., Ardmore—Thornton Fuller Auto Co., 125 East Lancaster Ave., awarded contract for the construction of a service station, on Haverford Rd. Estimated cost $150,000.

Pa., Philadelphia—General Electric Co., Witherspoon Bldg., having plans prepared for the construction of three 7 story buildings, to be 74 x 100 ft., 106 x 601 ft. and 74 x 103 ft. at Elmwood Ave. between 68th and 70th Sts. $1,500,000. Harris & Richards, Drexel Bldg., Archts.

Pa., Philadelphia — Philadelphia Storage Battery Co., Ontario and C. Sts., awarded contract for the construction of a 3 story, 54 x 250 ft. addition to manufacturing plant.

Pa., Philadelphia—Steel-Heddle Mfg. Co., 21st and Allegheny Sts., manufacturers of textile and mill supplies, will soon award contract for the construction of a 5 story, 145 x 212 ft. factory. Estimated cost $500,000. C. E. Wunder, 1520 Locust St., Archt.

Pa., Williamsport — J. E. Foucart Saw Works Co., J. E. Foucart, Pres., 411 West 3rd St., plans the construction of a 2 story, 31 x 210 ft. factory on Locust St. Estimated cost $150,000.

Tex., Cleburne — Gulf, Colorado & Santa Fe Ry. Co., 408 Union Depot Bldg., Galveston, awarded contract for the construction of a 122 x 517 ft. blacksmith shop, 45 x 228 ft. flue shop, etc., here. $205,000. Noted Mar. 11.

Wis., Milwaukee — F. Boddenhagen, Inc., 778 20th St., awarded contract for the construction of auto plant, North Ave. and 18th St. Estimated cost $85,000.

Wis., Milwaukee — Journal Co., 4th and State Sts., awarded contract for the construction 150 x 150 ft., garage and service station, Poplar and 4th Sts. Estimated cost $75,000.

Wis., Milwaukee — Loeffelholz Co., 170 Clinton St., is receiving bids for the construction of a 1 story, 52 x 140 ft. addition to foundry on Oregon St. Estimated cost $40,000. H. C. Haeuser, 445 Milwaukee St., Archt.

Wis., Milwaukee — Mack International Motor Truck Co., 25 Bway., New York City, awarded contract for the construction of 190 x 425 ft., plant at Grand Ave. and Highbury Pl., here. Estimated cost $200,000.

Wis., Milwaukee—M. J. Skubal Co., 149 Clinton St., awarded contract for the construction of 1 story, 67 x 100 ft. welding plant, South Pierce St. $30,000.

Man., Winnipeg—T. Eaton Co., Ltd., 190 Yonge St., Toronto, Ont., awarded contract for the construction of a 4 story, 100 x 120 ft. garage at 255-257 Carlton St., here. Estimated cost $155,000. Noted Mar. 11.

Ont., Port Colborne—International Nickel Co., Harbor Commissioners Bldg., Toronto, plans the construction of addition to electrolytic nickel plant, here. The first unit to increase the capacity from 350,000 to 950,000 lb. monthly. Estimated cost $750,000. Four additional units will probably be built later.